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MyForest

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Karnataka Forest Department

- Additions to the flora of Bangalore
- Plant powders as protectants
- Biodiversity Characterization by satellite and GIS
- Eco development strategy for degraded Forest

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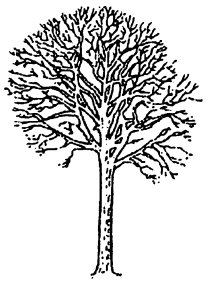

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ADDITIONS TO THE FLORA OF BANGALORE RURAL DISTRICT, KARNATAKA STATE

P.S. UDAYAN & K. RAVIKUMAR*

ABSTRACT

This paper enumerates 45 species of flowering plants collected from Savanadurga Medicinal Plants Conservation Area (MPCA) that forms new record to Bangalore Rural District.

Introduction

Savanadurga hill is an enormous mass of granite standing on a base of eight miles circumference. The MPCA is situated in the Savanadurga Reserve Forest, Magadi taluk, Bangalore Rural district. The latitude of the study area is 12° 55' N and longitude is 77° 19' E and the altitude ranges from 800-970 m above MSL. The total area of Savanadurga State Forest is 2662 hectares of which the MPCA forms nearly 280 hectares. The MPCA falls near the foothill of Bilibetta (=White hill) which is on the Western side of MPCA and is located just adjacent to the Savanadurga village. The general terrain is hilly and the major part of MPCA consists of small hillocks with interspersed forests. The wind direction is mostly southeast as the wind flow from the western side is blocked due to the mammoth Bilibetta and Karibetta. Ramaswamy and Razi (1973) while studied and compiled the flora of Bangalore district included Savandurga also in their study area. Bangalore district was divided into two during November 1, 1986, the one that covers the core part as Bangalore Urban district and the other covering village areas as Bangalore Rural district.

Forest type and Vegetation

According to Champion and Seth (1968), the forest is of Dry Deciduous Scrub. The vegetation of this MPCA is dry deciduous mixed with scrub jungles. In some places near the summit of rocky boulders where the forest is in a patchy pocket a few moist deciduous elements have also been noticed. The green cover is seen soon after monsoon rainfall and remains till the end of December, otherwise the forest will be dry with open canopies in major periods. The landscape of this forest is dominated by huge rocky hills with barren boulders strewn along the valleys, receive low rainfall and the sandy soil derived from the granite gneiss does not retain moisture for longer period resulting in the characteristic stunted growth of trees. Whereas few trees that are seen along the riversides near the western side of the entrance of the MPCA where the soil is of rich humus harboring rich herbaceous plants. These forests are however known to be very rich in medicinal plants.

Climate

The average rainfall in Magadi Taluk in which the Savanadurga MPCA is located is 804.9 mm in the last ten years. The

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maximum temperature usually during April goes up to 36° C and the minimum being 15° C during November. Generally the period between December to May is regarded as the drier period of the area.

Soil and geology

The soil is the higher zones are red and gravelly. The soil in the valley is usually loamy and is formed by accumulation of finer particles of the decomposed rocks washed down and deposited during the rains. The regions of laterite are intercepted by numerous 'nallahas' or deep ravines that expose the underlying decomposed gneissic rocks.

Rivers

A seasonal river namely Chikkathore flows along the northeastern boundary of the MPCA. An artificial reservoir by name Manchanabele is adjacent to the MPCA boundary.

Previous botanical exploration

Bangalore district earlier included in Mysore State, now the capital of Karnataka was first botanically explored by Buchanan-Hamilton (1807). Cameron (1894) studied the forest flora of Mysore and Coorg and described about 607 species including few exotics. Hooker (1855) in his "Sketch of the Flora of British India" has given general features of the vegetation of Mysore. Razi & Govindu (1952) have enumerated some characteristic plant associations of Savandurga and said that the vegetation resembles that of monsoon rain forest, especially during the months of October and February. Ramaswamy & Razi (1967) studied the vegetation of Savandurga and enumerated 332 species. Ramaswamy & Razi (1973) published the Flora of Bangalore district and enumerated 979 species. Sharma & *al.* (1984) studied the Flora of Karnataka and Saldanha (1984 & 1996) compiled the Flora of Karnataka included several species from Savandurga range.

Intensive botanical studies conducted in the MPCA from February 1997 to April 2002 comprising 1 to 4 days halt in 15 times. A total of 459 field numbers have been collected for herbarium specimens in all stages. This has resulted in the collection of 353 species including 264 genera belonging to 90 families, including 7 Red listed species and 4 ferns. No gymnosperm is recorded from this study area.

A critical study has revealed that 45 Species have neither been recorded in the flora of Bangalore district or in the Floras of Karnataka. A checklist of these species is presented here with updated botanical name followed by habit, vernacular names (Kannada) wherever available, family name, phenological data, habitat, specimens examined, altitude and data on distribution. All the species are presented in alphabetical order and the voucher specimens are deposited in the Herbarium of FRLHT, Bangalore. (FRLH).

Enumeration

1. *Acacia polyacantha* Willd. "Mugali mara". (Mimosacea) Trees. *Fl. & Fr.* : Apr.- Sept. Common in dry deciduous forests. *Specimen examined*: K. Ravikumar & P.S. Udayan 10038, on 05.05.97 at 860m. *Dist* : India and Sri Lanka.
2. *Allophylus serratus* (Roxb.) Kurz (Sapidaceae) Shrubs. *Fl.*: Aug. Occasional in dry deciduous forests. *Specimen examined* : K. Ravikumar & P.S. Udayan 00781, on 17.09.99. at 800m. *Dist* : Peninsula India and Sri Lanka.
3. *Balanophora abbreviata* Blume (Balanophoraceae) Herbs. *Fl. & Fr.*: Julys-Dec. Locally abundant in moist shady

areas along seasonal river. *Specimen examined*: K. Ravikumar & P.S. Udayan 06498, on 18.09.99.at 780m. *Dist*: Indo-Malesia and Africa. *Note*: So far reported only from Ranganthittu, Mysore district, Karnataka. (Saldanha, 1996).

4. *Bauhinia tomentosa* L. "Karana soppu, Maddalae mara". (Caesalpiniaceae) Shrubs. Fl. & Fr. : May-Jan. Rare, probably an escape. Specimen examined : K. Ravikumar & P.S. Udayan 02904, on 20.01.00. at 900m. Dist: Paleotropics.

5. *Biophytum reinwardtii* (Zucc.) Klotzsch (Oxaliadaceae) Herbs. *Fl. & Fr.* : June-Nov. Common in moist shady places. *Specimen examined* : K. Ravikumar & P.S. Udayan 06494, on 18.09.99 at 780m. *Dist* : Indo-Malesia.

6. *Bombax ceiba* L. "Elava, Booruga" (Bombacaceae) Trees. *Fl. & Fr.*: Feb.-May. Occasional along rocky slopes. *Specimen examined*: K. Ravikumar & P.S. Udayan 00774, on 03.01.98. at 860m. *Dist*: Tropical Asia.

7. *Bridelia airy-shawii* P.T. Li (Euphorabiaceae) Shrubs. *Fl. & Fr.*: Aug.-Feb.Occasional in open slopes. *Specimen examined*: K. Ravikumar & P.S. Udayan 13607, on 11.12.97. at 860m. *Dist* : Indo-Malesia.

8. *Ceropegia elegans* Wall. "Kari kaadu alasande" (Asclepiadaceae) Twining herbs. *Fl. & Fr.* : Sep.- Mar. Occasional in rocky crevices. *Specimens examined*: K. Ravikumar & P.S. Udayan 13563, on 10.12.97 and 06451 on 10.10.98. at 860m. *Dist*: Peninsula India and Sri Lanka.

9. *Ceropegia tuberosa* Roxb. "Kaadu alasande" (Asclepiadaceae) Twining herbs. *Fl. & Fr.* : Aug.-Feb. Occasional in rocky crevices. *Specimen examined*: K. Ravikumar & P.S. Udayan 06454, on 18.11.98. at 850m. *Dist* : Central & Southern Peninsular India, Sri Lanka.

10. *Cissus pallida* (Wight & Arn.) Steud. "Kadu drakshi balli, Mandaka balli" (Vitaceae) Erect shrubs. *Fl. & Fr.* : Oct.-June. Common in open areas. *Specimens examined* : K. Ravikumar & P.S. Udayan 10049, 05.05.97 and 11800, on 06.06.97 at 860m. *Dist* : India and E. Africa.

11. *Corchorus urticifolius* Wight & Arn. (Tiliaceae) Erect herbs. *Fl. & Fr.* : Aug.-Feb. Common in moist open areas. *Specimens examined* : K. Ravikumar & P.S. Udayan 11948, on 10.12.97; 06468, on 16.09.99 at 860m. *Dist* : Paleotropics.

12. *Dalbergia lanceolaria* L.f. "Pacharri mara" (Fabaceae) Trees. *Fl. & Fr.* : Jan.- Aug. Common in open forests. *Specimen examined* : K. Ravikumar & P.S. Udayan 11710, on 06.06.97 at 860m. *Dist* : India and Sri Lanka.

13. *Desmodium gangeticum* (L.) DC. (Fabaceae) Erect undershrubs. *Fl. & Fr.* : June-Dec. Common undergrowth in shady areas. *Specimen examined* : K. Ravikumar & P.S. Udayan 00766, on 12.12.97 at 860m. *Dist* : Tropical Asia, Africa and Australia.

14. *Diospyros chloroxylon* Roxb. (Ebenaceae) Armed small trees. *Fl. & Fr.* : Jan.-July. Occasional along forest edges. *Specimens examined* : K. Ravikumar & P.S. Udayan 10011, on 21.02.97 and 10040, on 05.05.97. at 860m. *Dist* : Endemic to Peninsular India.

15. *Dolichondrone atrovirens* (Roth) Sprague "Padhri mara" **(Bignoniaceae)** Small trees. *Fl. & Fr.* : Dec.-Oct. Common in open forests. *Specimens examined* : K. Ravikumar & P.S. Udayan 11711, on

06.06.97 and 13603, on 11.12.97 at 860m. *Dist*: Endemic to Peninsular India.

16. *Ficus arnottiana* (Miq.) Miq. "Kallarli mara, Bettadaarali" (Moraceae) Small glabrous trees or large shrubs. *Fl. & Fr.*: Jan.- June. Occasional in rocky slopes and crevices. *Specimens examined*: K. Ravikumar & P.S. Udayan 13526, on 03.01.98. at 860m. *Dist*: India and Sri Lanka
17. *Ficus hispida* L.f. "Garagatti, Olapatha, Medi" (Moraceae) Trees. *Fl. & Fr.*: Sept.-May. Common in moist shady localities. *Specimen examined*: K. Ravikumar & P.S. Udayan 14452, on 20.01.00. at 790m. *Dist*: Indo-Malesia to Australia and S. China.
18. *Gardenia latifolia* Ait. "Biligowjala mara" (Rubiacèae) Small trees. *Fl. & Fr.*: Feb.- Sept. Common in open forests. *Specimen examined* : K. Ravikumar & P.S. Udayan 11726, on 06.06.97. at 860m. *Dist* : Endemic to India.
19. *Grewia orientalais* L "Bekkina tharadu gida" (Tiliaceae) Shrubs or small trees. *Fl. & Fr.* : Jan.- Aug. Occasional in dry slopes. *Specimens examined* : K. Ravikumar & P.S. Udayan 11749, on 07.06.97 and 11746, on 20.01.00. at 870m. *Dist* : Tropical East Africa to Malesia.
20. *Hedyotis corymbosa* (L.) Lam. "Kallu sabseege" (Rubiaceae) Erect scabrid Herbs. *Fl. & Fr.* : Aug.-Jan. Locally abundant on the floor of moist to open areas. *Specimen examined*: K. Ravikumar & P.S. Udayan 13638, on 12.12.97. at 820m. *Dist*: Tropics.
21. *Hibiscus radiatus* Cav. "Kadu pundi gida" (Malbaceae) Diffuse undershrubs. *Fl. & Fr.* : June.- Dec. Common in shady localities. *Specimen examined* : K. Ravikumar & P.S. Udayan 06475, on 17.09.99 and 06463, on 19.11.98. at 800m. *Dist* : South & South E. Asia.
22. *Hymenodictyon orixense* (Roxb.) Mabb. "Nanju budlack mara" (Rubiaceae) Trees. *Fl. & Fr.* : July-Jan. Common in open forests. *Specimen examined*: K. Ravikumar & P.S. Udayan 11747, on 07.06.97. at 830m. *Dist* : Indo-Malesia.
23. *Ipomoea pileata* Roxb "Gowri gida; Jaji ambu" (Convolvulaceae) Twining herbs. *Fl. & Fr.* : July- Feb. Rare in on covered thickets. *Specimen examined* : K. Ravikumar & P.S. Udayan 06458, on 19.11.98. at 840 m. *Dist* : Indo-Malesia, Africa and China.
24. *Ixora pavetta* Andr. "Hennu goravi mara" (Rubiaceae) Shrubs. *Fl. & Fr.* : Jan.-Oct. Common in shady and open forests. *Specimens examined* : K. Ravikumar & P.S. Udayan 10003, on 21.02.97 and 10034, on 05.05.97. at 860m. *Dist* : India, Myanmar and Sri Lanka.
25. *Jasminum angustifolium* (L.) Willd. (Oleaceae) Climbing shrubs. *Fl. & Fr.* : Jan.-Oct. Common in open forests. *Specimen examined* : K. Ravikumar & P.S. Udayan 11729, on 06.06.97. at 860m. *Dist* : India & Sri Lanka.
26. *Jasminum roxburghianum* Wall. "Kadu mallige" (Oleaceae) Villous climbing shrubs. *Fl. & Fr.* : Jan.-June. Occasional in open thickets. *Specimen examined*: K. Ravikumar & P.S. Udayan 11756, on 06.05.97. at 830m. *Dist*: Endemic to South West India
27. *Jatropha tanjorensis* Ellis & Saroja (Euphorbiaceae) Shrubs. *Fl. & Fr.* : June-May. Occasional along forest hedges. *Specimen examined*: K. Ravikumar & P.S. Udayan 06499, on 18.09.99. at 820m. *Dist*: Endemic to peninsular India. Saldanha (1996) has not mentioned this species in his Flora of Karnataka. It is often planted along hedges in the districts of Bangalore, Chitradurga, Tumkur, Mysore and

Mandya.

28. *Lannea coromandelica* (Houtt.) Merr. "Kare goddhina mara, Udimara" (Anacardiaceae) Trees. *Fl. & Fr.* : Jan.-May. Common in open areas. *Specimen examined* : K. Ravikumar & P.S. Udayan 13513, on 03.01.98. at 860m. *Dist :* India and Sri Lanka.

29. *Miliusa tomentosa* (Roxb.) Sinclair (Annonaceae) Small trees. *Fl. & Fr.* : Jan.-Aug. Frequent in moist forests. *Specimen examined* : K. Ravikumar & P.S. Udayan, 06.06.97, on 11728. at 860 m. *Dist :* India and Sri Lanka.

30. *Neonotonia wightii* (Wight & Arn.) Lackey (Fabaceae) Climbing herbs. *Fl. & Fr.* : May-Nov. Common in dry localities. *Specimen examined* : K. Ravikumar & P.S. Udayan, 13641, on 12.12.97. at 820m. *Dist :* Paleotropics

31. *Ocimum gratissimum* L. "Rudra thulasi" (Lamiaceae) Aromatic subshrubs. *Fl.& Fr.* : Throughout the year. Common in open and shady places. *Specimen examined* : K. Ravikumar & P.S. Udayan, 13553, on 10.12.97. at 860m. *Dist :* Pantropics.

32. *Olea dioica* Roxb. "Madlae, Chattalae" (Oleaceae) Trees. *Fl. & Fr.* : Dec.-Oct. Common in moist humid areas, especially along riversides. *Specimen examined* : K. Ravikumar & P.S. Udayan, 14454, on 20.01.00. at 790m. *Dist :* Endemic to South West and North East India.

33. *Oropetium thomaeum* (L.f.) Trin. (Poaceae) Herbs. *Fl. & Fr.* : Oct.-Mar. Common in exposed moist areas. *Specimen examined* : K. Ravikumar & P.S. Udayan, 1 1907, on 07.06.97. at 900m. *Dist :* Tropical Africa, India

34. *Pisonia aculeata* L. "Antuhannu gida" (Nyctaginaceae) Climbing shrubs. *Fl. & Fr.* : Sept.- Feb. Occasional in open dry forests. *Specimen examined* : K. Ravikumar & P.S. Udayan, 00764, on 12.12.97. at 850m. *Dist :* Pantropical.

35. *Polygala rosmarinifolia* Wight & Arn. (Polygalaceae) Erect or prostrate herbs. *Fl. & Fr.* : Aug.- Mar. Common in moist shady places. *Specimen examined* : K. Ravikumar & P.S. Udayan, 11742, on 07.06.97. at 820m. *Dist :* India and Sri Lanka

36. *Portulaca pilosa* L. ssp. *pilosa* var. *tuberosa* (Roxb.) Sivar. (Portulacaceae) Perennial succulent tuberous herbs. *Fl. & Fr.* : June- Dec. Common in open grassy patches of sandy soil. *Specimen examined* : K. Ravikumar & P.S. Udayan, 11715, on 06.06.97. at 860m. *Dist :* India and Sri Lanka

37. *Pseudoraphis spinescens* (R. Br.) Vickery (Poaceae) *Fl. & Fr.* : Aug.-Mar. Locally abundant in water bodies. *Specimen examined* : K. Ravikumar & P.S. Udayan, 13649, on 12.12.97. at 840m. *Dist :* India, Sri Lanka, S.E. Asia and Australia.

38. *Rivea hypocrateriformis* (Desr.) Choisy "Gandusihiaaleballi" (Convolvulaceae) Climbing shrubs. *Fl. & Fr.* : Apr.-Dec. Common on thickets of open forests. *Specimens examined* : K. Ravikumar & P.S. Udayan, 06459, on 19.11.98; 13531, on 03.01.98 and 06470, on 16.09.99. at 760m. *Dist :* India and Sri Lanka.

39. *Rungia pectinata* (L.) Nees (Acanthaceae) Decumbent herbs. *Fl. & Fr.* : Throughout the year. Commons in moist localities of shady places. *Specimens examined*: K. Ravikumar & P.S. Udayan, 06491, on 17.09.99 and 14455, on 20.01.00 at 790m. *Dist:* Burma and Sri Lanka.

40. *Schleichera oleosa* (Lour.) Oken "Kodali muruku mara" (Sapindaceae) Trees. *Fl. & Fr.* : Jan.- July. Occasional in open forests. *Specimens examined* : K. Ravikumar & P.S. Udayan, 11727, on 06.06.97. at 860m. *Dist :* Indo-Malesia.

41. *Securinega virosa* (Willd.) Baill. "Bilesuli ,Hulea mullu, Koorambelu, Gada hallae" (Euphorbiaceae) Shrubs. *Fl. & Fr.*: Dec.-Aug. Common in open scrubs. *Specimens examined*: K. Ravikumar & P.S. Udayan, 11753, on 06.05.97. at 830m. *Dist:* Paleotropics.

42. *Stereospermum colais* (Buch.-Ham. ex Dillw.) Mabb. (Bignoniaceae) Trees. *Fl. & Fr.* : Jan.-Nov. Occasional in open forests. *Specimens examined* : K. Ravikumar & P.S. Udayan, 13546, on 07.05.98. at 850m. *Dist :* Indo-Malesia.

43. *Strychnos potatorum* L.f. "Chilladha mara, Chilli-bija, Chali" (Loganiaceae) Medium sized glabrous trees. *Fl. & Fr.*: Oct.-May. Common in shady zones. *Specimens examined*: K. Ravikumar & P.S. Udayan, 10022, on 21.02.97. at 820m.*Dist :* India and Sri Lanka.

44. *Triumfetta pentandra* Rich. (Tilliaceae) Herbs. *Fl. & Fr.*: July-Mar. Occasional in dry open areas. *Specimens examined*: K. Ravikumar & P.S. Udayan, 00752, on 12.12.97. at 850m. *Dist :* Tropical Africa, India and Sri Lanka

45. *Ventilago denticulata* Willd. (Rhamnaceae) Liane. *Fl. & Fr.* : Nov.-May. Occasional on thickets in open forests. *Specimens examined* : K. Ravikumar & P.S. Udayan, 14456, on 20.01.00 and 14464, on 21.01.00. at 790 m. *Dist :* Endemic to India.

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BIO-DIVERSITY CHARACTERIZATION AT LANDSCAPE LEVEL USING SATELLITE REMOTE SENSING AND GEO-GRAPHICAL INFORMATION SYSTEM (GIS)

P.S. ROY[@], B.K. RANGANATH[$], BALAKRISHNA GOWDA *

ABSTRACT

India is known for its diverce Bio-climatic regions supporting plants and animal species representing 7% of the worlds Flora and 6.5% of worlds Fauna. Bio diversity characterization at landscape level using satellite remote sensing an geographical information system an attempt to qualify species richnes, Bio diversity valuation and phyto sociological analysis and use these to characterize bio-diversity was made. Maps of vegitation and land cover types, fragmentation disturbence regimes, biological rich ness zones etc. are some of the important ouput generated in the present study.

Introduction

India is known for its diverse bio-climatic regions supporting one of the richest flora and fauna. Our country is one among the top 12 mega-diversity countries in the world in terms of bio-diversity .Its immense biological diversity is estimated to be over 45,000 plant species and 81,000 animal species representing 7% of world's flora and 6.5% of world's fauna respectively. At present, the biological diversity encompassing a vide range of eco-systems, species and genetic forms are under serious threat due to rapidly growing population, forest fires, industrialization, multipurpose river valley projects, encroachments, uncontrolled grazing, landslides etc. It is important that these pressures are tackled, downslides are arrested and the ecology of the areas protected. Thus, there is an urgent need to conserve the gene pool *in-situ* and *ex-situ* before it is lost forever.

India is a signatory of the International convention of biological diversity and is committed to undertake identification and monitoring of the components of biological diversity important for their conservation and sustainable utilization. In this context, the Dept. of Bio-technology (DBT) and Dept. of Space (DOS) jointly launched a study on bio-diversity characterization.

The project on "Bio-diversity Characterization at Landscape Level using Satellite Remote Sensing and Geographical Information System" is the first of its kind at National level attempted in three Bio-geographical zones viz., Western Ghats,

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North Eastern region and Western Himalayas. This is the first attempt to quantify species richness, Bio-diversity valuation and phyto-sociological analysis and use these to characterize bio-diversity in conjunction with other ecological parameters. Methodology has been developed to analyze and prioritize different eco-systems for conservation using existing knowledge and assessing the disturbance impacts / regimes by way of investigating and inventorying biological richness of the areas. This multi-institutional project has the participation of several organizations of excellence like Botanical Survey of India, Wild Life Institute of India, CB Pant Institute of Himalayan Environ ment and Development, French Institute, Pondicherry, Universities and various specialized remote sensing centres of Dept. of Space .

Objectives

The project is carried out with the following objectives.

- Preparation of Vegetation cover type maps using satellite remote sensing data incorporating topographical details and bio-geographical classification of India.
- Landscape characterization to identify disturbance gradient using CIS.
- Prioritize bio-prospecting areas for bio-diversity conservation using CIS.
- Detailed assessment of bio-diversity and its distribution pattern at species and community level.

Approach

The spatial data on forest vegetation and land use are generated using satellite remote sensing data through digital classification. Database on slope, drainage, road and settlement network, administrative boundaries etc. are created in a CIS domain for further analysis. The spatial and non-spatial data from other ancillary data sources are combined to generate habitat maps. Landscape analysis is carried out to determine the parameters like fragmentation, porosity, proximity from settlements and roads, interspersion and other patch characteristics to derive disturbance regimes. The biological richness at landscape is determined as a function of eco-system uniqueness, species diversity, bio-diversity value, terrain complexity and disturbance index.

The ground data collected from the sample plots on the life forms (trees, herbs, shrubs, climbers, epiphytes) distribution vegetation wise is analyzed to derive information on species richness, eco-system uniqueness and bio-diversity value. The uniqueness of the eco-system is determined based on species composition and its categorization based on IUCN criteria and red data book. The species richness, which is the number of species in a sample or habitat, is calculated by analyzing the relative frequency, dominance, abundance and importance value index. Shannon-weaner index and Simpson's index are used to determine species richness. The biological value for each vegetation type was generated based on the potential economic uses of each species viz., medicine, food, fuel, forage, charcoal, wood, oil, resin, dye, tannin etc., is generated.

Outputs

Maps of vegetation and land cover types, fragmentation, disturbance regimes, biological richness zones etc., are some of the important outputs generated in the present study. The vegetation type map provides the spatial distribution and extent of different vegetation and land cover categories. The fragmentation map indicates continuity of vegetation, its fragmentation status etc. The disturbance regimes provide information on the eco-systems, which are under stress. The biological richness asserts the areas, which should be treated on priority in decision-making and management level for conservation of bio-diversity. Habitat identification and economic importance of the species will be an useful input for bio-prospecting and bio-diversity conservation. In Karnataka the study has been carried out in 9 districts of Western Ghats viz., Belgaum, Dharwad, N.Canara, S. Canara, Shimoga, Chikmagalur, Hassan, Mysore and Kodagu. The final maps on 1:250000 scale have been generated in the form of Atlas. The information generated in the project is being organized in the form of Bio-diversity Information system (BIS), which would be web, enabled.

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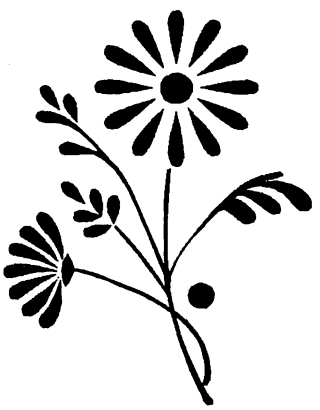

GOVERNMENT OF KARNATAKA

No DPAR 44 SFP 2003

Karnataka Government Secretariat
Vidhana Soudha, Bangalore

Dated 3rd May, 2003

NOTIFICATION

The Services of Shri Vijay Lal Meena, IFS (KN 94), Deputy Conservator of Forests, Zilla Panchayat, Uttara Kannada District, Karwar, are placed at the disposal of Water Resources Department with immediate effect and until further orders for posting him as Deputy Conservator of Forests & District Project Coordinator, Jala Samvardhane Yojana Sangha, Kolar, in the newly created post.

The Services of Shri Ashwini Kumar Singh, IFS (KN 97) Deputy Conservator of Forests, Zilla Panchayat, Chamarajanagar District, Karwar, are placed at the disposal of Water Resources Department with immediate effect and until further orders for posting him as Deputy Conservator of Forests & Distict Project Coordinator, Jalal Samvardhana Yojana Sangha, Raichur, in the newly created post.

The services of Shri R, Manoj. IFS (KN 99), Senior Assistant Conservator of Forests, Janmane Sub-division, Janmane, are placed at the disposal of Water Resources Department with immediate effect and until further orders for posting him as Deputy Conservator of Forests & District Project Coordinator, Jala Samvardhane Yojana Sangha, Tumkur, in the newly created post.

The services of Shri S.S. Lingaraja, IFS (KN 99), Senior Assistant Conservator of forests, Zilla Panchayat, Uttara Kannada District, Karwar, are placed at the disposal of Water Resouces Department with immediate effect and until further orders for posting him as Deputy Conservator of Forests & District Project Coordinator, Jala Samvardhane Yojana Sangha, Haveri, in the newly created post.

BY ORDER AND IN THE NAME OF THE
GOVERNOR OF KARNATAKA

(B. V. Kumarswamy)
Under Secretary to Government
D. P. & A. R. (Services-I)

MyForest, June, 2003
Vol. 39(2) Page Nos. 113-116

STRATEGIES FOR THE CONSERVATION OF SOME GENETICALLY IMPOVERISHED AND ECONOMICALLY IMPORTANT SPECIES IN KARNATAKA[1]

S. RAJENDRAN[2]

ABSTRACT

The Karnataka state has many natural resources. The forest is one of them. Human and cattle exert a lot of pressure on the forests for obvious reasons. Consequently the huge natural populations of economically important species in the forests are becoming small and small in Karnataka state. The loss of genetic variability in small populations is detrimental to the very existence of the species. Ten economically important but genetically becoming impoverished species are identified and recommended for immediate conservation of their dwindling genetic resources through the participation of the local people, the respective exploiting industries, the Karnataka Forest Department and the NGOs.

Introduction

1. The Karnataka state has endowed with many natural resources. The forest is one of them. The forests are considered as socio-economic resources and have social and economic objectives. The forests are the genetic reservoirs of the species found in them. Many species are exploited for raw materials to be used in the forest-based industries.

2. The Western Ghats Forests of Karnataka are recognized as one of the 18-mega biodiversity centers of the world. The Biodiversity is nothing but the geographic genetic variability found in the species. The nature has distributed and preserved genetic diversity of species in the forest since millions of years. The underlying factor for survival of the species for a long time is their adaptation in time and space due to their genetic diversity, which makes them fit to face the onslaught of man and cattle.

3. Though the species withstood the pressure from man and cattle for a long time, now they are no longer in a position to withstand the pressure on their habitats. Many species have become extinct already and many huge natural populations of species are becoming small and small. Eventually one day they will also disappear. During 1999, IUCN's.

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1 Paper presented in the national workshop on Conserving Forest Genetic Resources organized by the ATREE, Bangalore on July 18-19, 2000 at the IWST, Bangalore - 560 003

2 Chief Conservator of Forsests and Chief Executive Officer, Karnataka State Medicinal Plants Authority (KAMPA), Bangalore - 560 076.

Species Survival Commission (SSC) reported that over 34,000 species of plants were threatened with extinction (about 12.5% of the world's flora). The Karnataka state is no exception and there is no study to identify such threatened species.

POPULATION SIZE AND GENETIC VARIABILITY OF SPECIES:

4. The loss of genetic variability in small population has both qualitative and quantitative aspects. Qualitatively specific alleles for specific characteristics either will be lost or retained. The loss of alleles especially rare ones cannot be replaced when they are lost. Quantitatively the amount of variability for specific characteristics will be reduced. when numbers are low, a population is in effect going through a serious bottleneck every generation and the effects are cumulative because the regeneration of variation by mutation is insignificant in small populations. Small populations rapidly loose genetic variations.

5. The leakage of alleles is very very less in a large population. One of the characteristics of a genetically ideal population is that the members of progeny of a species are randomly distributed.

6. Many economically important species are exploited for commercial purposes and used as raw materials for forest based and cottage industries.

7. Biodiversity in all the three levels ie, genes, species and eco-system are used for the economic development of man, causing irreparable and irrversible damage to the very existence of such species.

8. Man has already reduced the forest resources by manipulating the living space available to many species. Many species have become extinct and many have entered in to the Rare Endangered and Threatened (RET) list of species. It is the extinction and not survival, which provides motives for conservation.

9. In Karnataka State also, in the past and the present, many such commercially important species are over-exploited to support the industries and consequently their population are going on decreasing and their availability as raw materials for the industries on sustained basis is at stake. Indiscriminate exploitation of such species is leading to their wide genetic base shrinking. There is a great deal of genetic impoverishment in them. Their genetic variability is being lost. Unfortunately many native forest tree species of commercial value have been lost already in Karnataka and elsewhere. Some spices will be practically lost in due course of time in Karnataka (refer. **Table No. 1**) unless some effective measures are taken to conserve their genetic resources.

10. **Table No. 1** depicts the most 10 commonly exploited commercial species in Karnataka, which require immediate attention for their genetic conservation.

Some genetically impoverished species of Karnataka

Sl.No.	Name of the species	Common name	Reasons for genetic impoverishment	Name of the user industries.
1	*Acacia catechu*	Khair Kaachu	Over-exploitation and habitat shrinkage	Cottage
2	*Ailanthus malabaricus*	Dhupa	-do-	Perfume
3	*Calamus* sps.,	Canes	-do-	Furniture
4.	*Dalbergia latifolia*	Rose wood	-do-	furniture
5.	*Dendrocalamus strictus*	Small bamboo	-do-	Cottage & paper
6.	*Diospyros ebenum*	Ebony	-do-	furniture
7.	*Dysoxylum malabaricum*	Wehita cedar	-do-	Furniture & building
8.	*Persea macrantha* (Machilus macrantha)	Gulmavu	-do-	Agarbathi
9.	*Pterocarpus marsupium*	Honne	-do-	Building
10.	*Santalum album*	Sandal	-do-	Soap & perfume

Strategies for conservation

11. The analysis of the above table brings out the fact that overexploitation and shrinkage of the habitats of the above 10 species is the main reason for the genetic impoverishment of the above species. Therefore our aim is to see that the above species are exploited sustainably and their habitats are protected from encroachments.

12. The immediate step in conserving the genetic resources of the above mentioned species is to study their distribution, ecology, identification of genetic variations, their ecotypes and ecosystems. The collection of seeds from different known provenances, their evaluation, establishment of their exclusive conservation stands in a variety of sites in natural forests including national parks and sanctuaries will go a long way in conserving the genetic variations of the above species.

13. The most economic and safe means of genetic conservation is the establishment of clone and seed banks for each of these species in and *ex situ* and further following an appropriate breeding technology of such species.

14. Once quality seeds are obtained from the clonal plantations, a large number of seedlings must be raised. The plantations of the above species must be raised in large areas every year without any breakup. This alone will ensure the genetic conservation of the above species.

15. We must produce a number of data sheets on commercially exploited species, which provide basic information essential to their effective genetic conservation.

Conclusion:

16. The object of safeguarding the forest genetics resources is to preserve the diversity of species for the benefit of future generations. It ensures the sustainable suply of required raw materials for the forest-based and cottage industries. The full conserved forests fulfill the socio-economic objectives of the country.

17. A lot of funds are required for the genetic conservation of many species. For this, we must involve the forest based industries concerned and the State forest Development Corporations for corporate and project funds.

18. For conservation of forest genetic resources, it is important to conserve a wide range of different provenances of species. The most logical approach to conserve the genetically impoverished commercially important species *in situ* is to conserve the forest ecosystems and it takes care of the conservation of the genetic resources of the species it contains. For this we must involve the local people through the Joint Forest Protection Management (JFPM) and NGOs.

19. It is better to take immediate action to conserve the forest ecosystems than to suffer after the loss of commercially important species once for all.

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DEVELOPING AN ECODEVELOPMENT STRATEGY FOR A DEGRADED FOREST VILLAGES OF ANDHRAPRADESH

T. Narayanaswamy*, D. Raghupathi, Bharati C. Mirajkar** and L.T. Basavaraj****

ABSTRACT

Deteriorated ecological situation is causing concern about the very survival of tribal development in forest. The ecosystem component sub-systems such as human settlements, food consumption, wild life etc., are interwoven with each other bestowing with harmonious balanced network in the nature. This was disturbed because of shifting cultivation, excess fuelwood collection over grazing etc. The study was conducted in the Boithili village of Vishakpatnam district, part of the district had large number of tribal families which earn their livelihood by collecting forest resources spending 12.5 hrs. per day. They dwell in mudwall-thatched roof huts with two halves-partitioned congested spaces. Their staple food is Rice and Ragi and they buy Sugar, Oil, Flour etc., from society and shandy, spending nearly Rs.6000/- per family per annum. The farmers harvest low yields of Rice, Ragi and Turmeric, because of shifting cultivation. Milking is a taboo and tribals earn marginal income by selling meat and non-timber forest produce in the neighboring villages and in shandy places. In this connection a strategy was developed to improve human settlements.

Key words: Cropping system, grazing milch animals, shifting cultivation.

Introduction

Land is a scarce resource, the human beings and their associate biological demands are plenty. To meet the demands there is a need to exploit the scarce resources optimally without affecting eco-system. Now, there is a need to conserve such resources at any cost and the time has come where the economists have to redefine the poverty not as a shortage of cash but biomass resources to meet the basic needs (Narayanswamy 1992). A concept like Gross Nature Product seemingly more relevant than present Gross National Product to measure the nation's wealth. Increased population pressure at geometric proportion has rendered a fast depletion of resources in the form of deforestation, soil erosion, water resources etc. These are apparent today and are causing concern to scientists and managers to develop strategies for eco-development. Indian Institute of Forest Management sponsored this research project for Post graduate Diploma in Forest management during 1999. There is a need to develop ideal eco-strategy to villages in

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the forest, which are responsible for degradation and to restore the ecosystem. Keeping these aspects of ecology in view the study was conducted with the following objectives:

1. To find out existing status of ecological sub-systems; and
2. to develop an eco development strategy for sustainable management of resources.

Materials and method

The tribal village Boithili was treated as micro ecosystem to examine the utility of resources. It consisted of different component sub-systems such as, subsistence agriculture, animal husbandry, forests, grazing lands and water bodies. Ecosystem analysis was done developing a structured questionnaire, fitting the aforesaid components and its usage pattern.

Sample

One hundred and twenty (120) tribals constituting thirty percent of total tribal population were randomly interviewed and was considered as sample. Stratified sampling procedure was adopted for interview and observation of the respondents and the situation. Interview was conducted under natural setting and in-groups as to reduce the influence of on lookers.

Secondary source of data was collected from local institutions. Participatory eco-system appraisal technique was used for assemblage of information from different angles.

Research design

Ex post facto *and survey* type design was used to elicit the information from the respondents.

Measurement

The variables have been measured with simple statistical tools like frequency and the per cent.

Resultus and discussion

Existing ecological sub systems: Essential resources available in the study area were forests, water bodies, animal husbandry, agriculture etc.

Extent of resource exploitation: Almost all the members of the family were engaged in making use of available resources, spending 16 hours per day by each family to draw water and collect fuelwood and non timber forest produce **(Table-1)**.

Human settlement: The tribals dwell in mud and thatched houses. Water was drawn from streams and hand pumps. The house was partitioned into two halves, the whole domestic works operate within this two halves, unlike that of rural and semi urban houses, where additional portions are created for different purposes.

Food consumption: Rice and ragi were the staple foods. Consumption of liquor prepared from fish tail and palm tree (*Caryota urens)* was customary and consumed daily. Sugar and salt were purchased in weekly shandies. The average expenditure for purchase of aforesaid items per family worked out to be Rs.5901.33 per annum. **(Table-2)**

Agriculture: The per capita cultivated land availability was 1.61 acres. Traditional shifting cultivation was being practiced. Often forest was cleared by felling and burning trees, raising two to three crops for two to three years on this temporary nutrient rich soil. Later, abandoned for natural growth for few years before they return to the same land. This type of cultivation was partly responsible for eco-degradation leading to xeric conditions.

The major crops grown were Turmeric, Paddy and Ragi. The total production of Turmeric was 15.87 tons per year, with an average yield of 768.13 kgs per acre. The

marketable surplus was 6.4 tons per year. Paddy was major crop grown in 37.17 acres with an average yield 5.16 qtl/ac. The estimated production was 19.40 tons per season or 38.00 tons per year. Dependence on rice for consumption from market was 26 tons per year. In case of Ragi, the average area available for cultivation was 1.13 acs per household with an average yield 245.64 kgs/ac (against potential yield 400 kg/ac). The total production of food grains estimated was 14.38 ton per year but requirement was 22.18 tons per year. The deficit requirement was met from outside market **(Table-3).**

Energy for domestic needs: The fuel wood tree species preferred were Tada (*Grewia tiliifolia),* Jamun (*Syzigium cumini)* Mango (*Mangifera indica)* and Jack.

(*Artocarpus heterophyllus).* The firewood was used to keep their bodies warm during winter and boiling of turmeric, apart from cooking **(Table-4).**

Live stock sub system: The total live stock population was 239 **(Table-5).** Average live stock per household was four. Animals were reared for draft purpose (both cows and bullocks). Milking of cow was social taboo, and perceived as sin, the average annual income on sale of meat was Rs.449.43 **(Table-6).** The fodder consumption pattern is given in **(Table-7).** Indicating erratic and over – grazing and making the forest regeneration affected further.

Forest and grass lands: The tribals depended on forest for fruits, firewood, fodder and other minor forest produce. The average annual income generated from sale of produce was Rs.505.05 per household **(Table-8).** From the above statements of biomass production it may be inferred that the tribals and the forest ecosystems have strongly interwoven which should be strengthened further.

Eco development strategy

Human settlement: Thatched mud houses with grass roofing were constructed in two rows facing each other. The material used for construction may not be long-lasting. Burnt bricks for wall and bamboo for support and roofing can be suggested. Since the houses are congested with just two halves, have to be further partitioned creating small rooms for kitchen, bedroom, storage rooms etc., by using the resources available in the forest itself by seeking technical guidance from NGOs or other institutions serving for tribal welfare.

Food consumption: The tribals cultivated two cereal crops such as, Rice and Ragi and purchasing other food grain items (sugar, oil, pulses etc) from the society or in the shandies. For these items they incur expenditure to the tune of Rs. 5901.33 per annum per house hold, which is a burden to them. Introduction of oilseed and pulse crop would lighten the burden.

Agriculture sub system: The mis-conception and strongly held predisposition of shifting cultivation should be erased, which had far reaching negative consequences of eco logical disturbance. Some of the recent location specific eco-friendly technologies have been introduced such as organic farming, multiple cropping system with pulse and oilseeds, improved varieties of Rice and Ragi, replacing turmeric crop with other cash crop, so that collecting firewood from forest for processing turmeric crop can be avoided.

Energy for domestic needs: By felling the trees and shrubs the tribals used them for firewood and other purposes. Introduction of improved chullas, biogas plant (energy) would go a long way as alternate low cost technologies to reduce the felling of trees. Educating the tribals to use only lops and tops, dry and dead wood etc, for cooking and other purpose.

Livestock and pasture: Before introduction of milch animals the prevailing social taboo (not to milk cow) has to be removed through educational awareness. Introduction of high yielding milch animals would help dual purpose. One is motivating them to go for stall feeding and reducing over grazing and educating about milk uses and removing negative attitude-taboo 'milking is a sin" and earning income from selling milk. Introduction of sheep, piggery and poultry also has potential scope for earning additional income to increase the purchasing power of tribals. A system should be established in such a way that tribals collect all the NTFP regularly by the individuals identified and sell in regulated market or cooperative society run by them to ensure regular income without falling into middleman trap.

Conclusion

The tribals were not aware of improved technologies developed by research institutes as a consequence, they continued their traditional practices, which are mostly of taboo based and other cultural practices. As a consequence, there was disturbance in ecological balance. Further, poor nutrition, shelter and income earning threatened their lives. The strategy designed in this study (Figure) for the purpose of ecological balance would go a long way for sustenance of ecological and human relationships.

Table 1 – Time spent for resource exploitation by the tribals in the forest

Sl.No	Resources use	Female (Hours / day)	Male (Hours / day)	Children (Hours / day)
1	Collection of Water	2.0	1.0	0.5
2	Collection of fuel wood and non- timber forest produce.	4.0	5.0	3.5
	Total	6.0	6.0	4.0

Table 2 – Food consumption pattern among the tribals

n=120

Sl.No	Food stuff	Quantity consumed (kgs/lits)per family per annum
1	Rice	733.00
2	Ragi	357.80
3	Minor millets	161.10
4	Pulses	44.00
5	Oils	16.90
6	Vegetables	79.50
7	Tea	7.30
8	Sugar	33.80
9	Meat	19.30
10	Liquor	58.30

The annual expenditure for these items was estimated Rs. 5901.33
(Based information collected during ecosystem analysis)

Table 3 – Agricultural input and output analysis

n=120

Crops	Bullock power (hour)	Man Power (hour)	Seed (Kg)	FYM (Kg)	Fertilizers (Kg)	Pesticides (Kg)	Food grains (Kg)	Straw (Kg)	Husk (Kg)
Paddy	95.33	190.38	36.08	313.66	0.0	0.0	515.94	774.38	251.11
Ragi	43.83	105.23	5.44	8.09	0.0	0.0	245.64	402.94	0.0
Turmeric'	6.58	187.06	148.13	106.33	0.0	0.0	768.13	0.0	0.0

Table 4 – Category wise firewood demand for socio cultural requirements in the village

n=120

S.no	Wood utilisation Pattern	Use/household (Tons/year)	For entire Village (Tons/year)
1	Cooking	4.48 (64.18)	278
2	Boiling of Turmeric	0.84 (12.04)	52.09
3	Warming	1.66 (23.78)	103.05
	Total fire wood	6.98	434.14

Values in parenthesis indicate percent

Table 5 – Livestock population of the village

n=120

S.no	Livestock	Number
1	Cows	96
2	Bullock and oxen	67
3	Buffaloes	08
4	Horses	05
5	Goats	63
6	Poultry	171
	Total	239*

*Excluding the poultry birds

Table 6 – Income generation from animal produce

n=120

Sl.No	Category	Income (Rs/ year)
1	Sale of animal produce (FYM, wool)	55.55
2	Sale of animals (Cattle, Goat etc.)	393.88
	Total	449.43

Table 7 – Fodder consumption pattern per animal

n=120

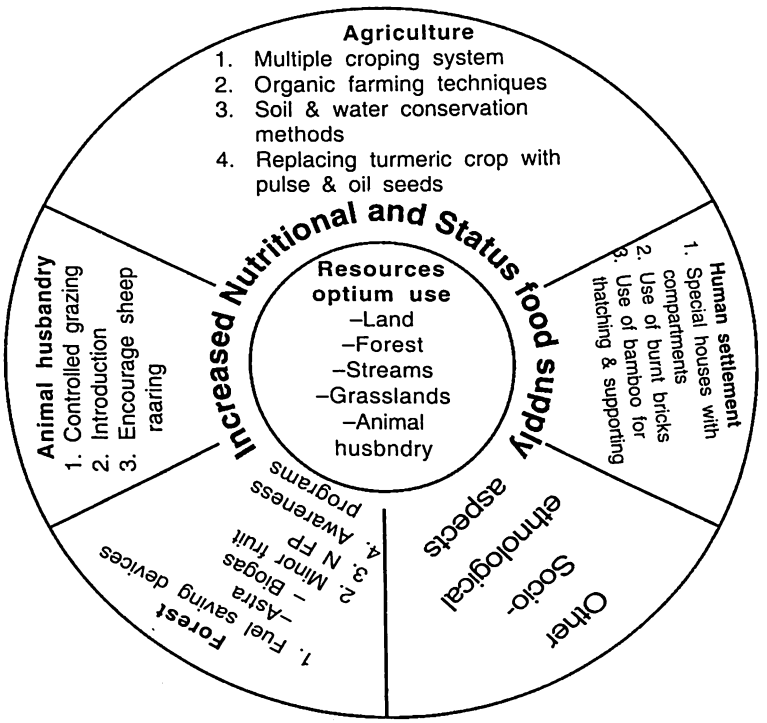
Sl.No	Fodder	Quantity (kgs/year)
1	Green	6006.27 (83.15)
2	Hay	1054.44 (14.61)
3	Paddy husk	155.05 (2.24)
	Total	7215.76 (100.00)

Parenthesis values indicate per cent to the total fodder consumption.

Table 8 – Annual collection of firewood and income generation by the average family from the forest

Sl.No	Produce	Quantity (kgs/year)	Income (Rs)
1	Firewood	6986	41.73
2	Fruits	12.11	27.44
3	NTFPs	4010	435.88
	Total	-	505.05

Non timber forest produce includes, adda (beedi) leaf, broomstick, soap, nut, honey tamarind, agave etc.



Ecodevelopment strategy

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KARNATAKA FOREST DEVELOPMENT CORPORATION LIMITED

(A Government of Karnataka Undertaking)

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Raising of Eucalyptus plantation with the main object of selling Eucalyptus wood to wood based industries and sellers of Eucalyptus citriodora oil to aromatic industries.

Manufacturers and sellers of natural rubber products, like centrifuged latex of 60% DRC (ISI Marking), skim crepe, latex crepe, EDC 1X, 2X, 3X, milling waste, waste lump, EBC (off grade), etc., to rubber based industries.

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ROLE OF SOME INDIGENOUS PLANT POWDERS AS PROTECTANTS OF MAIZE GRAINS AGAINST PESTS MYCOFLORA AND GERMINATION

MAYA C.

ABSTRACT

Production of maize ranks third in India amongst cereals. Due to prevailing hot and humid climate and improper post harvest preservation technique, coniderable part of the produce (particularly maize) is fungi. This not only reduces the germinability of the grains considerably but also the nutritive quality, thus rendering the grains of poor quality, both for sowing purpose and for human consumption (Christensem, 1973; Nzndi et. al., 1996). Comparative efficacy of the byproducts of few locally available forest trees and few medicinal plants were tested for their insecticidal and fungicidal properties on Maize grains for long period with less number of pests and fungal population. In the case of neem seed powder, 4 gms/250 gms proved to be standard dosage. The dry leaf powders of *Azadirachta indica, Eucalyptus, Mentha piperita, Pongamia glabra,* and bulb powder of *Allium sativum* were more effective at higher concentrations.

Key words: *Azadirachta indica, Eucalyptus, Mentha piperita, Pongamia glabra, Allium sativum, Trigonella foenum-graecum,* pests, mycoflora, germination.

Introduction

The method of controlling pests, mycoflora by the use of biocides have several consequences such as the development of resistance, problems associated with residues and cost factor. Therefore, it becomes necessary to identify and isolate substances from natural products that are being indigenous, exhibit low mammalian toxicity and surface persistence tests for long time with no adverse effect on seed germinability.

The possible use of miscellaneous plant products to control stored cereals has attracted attention from the past few decades. In rural India, practices such as mixing of sand, ash etc. are commonly practiced with the aim of minimising storage losses and also to maintain the quality of seed.

Lokesha and Somashekar (1989) evaluated the products such as mixing of grains and pulses with glumes of ragi, dried sand, ash and paddy husk as a protectant against pests and mucoflora during storage period. Leaves of neem (*Azadirachta indica*) have also been used to protect the stored grains against insects (Pruthi et. al., 1950). In view of the above, the present study was carried out to compare the efficacy of the byproducts of a few locally available forest trees *viz. Azadirachta indica, Eucalyptus citriodora, Pongamia glabra* and few medicinal

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plants like *Mentha piperita, Trigonella foenum-graecum* and *Allium sativum* with the aim of controlling grain storage pests and mycoflora and increase germination.

Materials and method

In the present study, the miscellaneous products of *Azadirachta indica, Juss. Pongamia glabra* L, *Mentha piperita* L. Eucalyptus citriodora HK. Trigonella foenum-graecum L. and *Allium sativum* L. were screened for antiungal and insecticidal properties on *Zea mays* L.

The dust-free and healthy leaves of neem, karanj, mint, eucalyptus species were selected, washed with distilled water, dried in shade and powderd. Similarly, bulb of garlic and seeds of neem, trigonella etc. were dried and powdered. The powdered leaves with the dosage of 2, 4, 6, & 8 gms., garlic bulb powder with 2, 3, 4 & 5 gms. and seed powders of 2, 4, 7 & 10 gms. were treated on 250 gms of healthy grains. The treated grains were stored in cloth lined gunny bags.

A control set without plant material of any form was maintained. All the experiments were replicated three times. The treated grains were screened at tri-monthly intervals till 36 months to evaluate

- Percent infestation.
- Percent grain damage by mycoflora.
- Percent germination.

The qualitative and quantitative studies of grain mycoflora was carried out by employing blotter and agar plate method and the germi nability test of treated grains was estimated as per ISTA specifications (ISTA 1976).

Results and discussions

Data on the efficacy of plant meterials as protectants on grains against pests and mycoflora is presented in fig. **1a-1g & 2a-2g.** The seed powder of neem, karanj and triogonella were comparatively more effective than the bulb and leaf powders. The non-infection period observed amxng treated grains ranged between 9 to 15 months. The number of pests and fungal colonies on the grains varied among each treatment.

At higher concentrations of the powder, there was a gradual reduction in the grain damage. Subsequently, the fungal population increased gradually to a certain storage period and declined thereafter till the end of the storage **(fig. 2a-2g).** While the percentage germinability was also dependent on dose and duration.

Observations on the percent damage caused by weevils *viz. Sitophylous oryzae. S. cereallela* and *Rhizopertha dominica* affecting and *Z. mays* was reduced when treated with the lowest dosage of 4 gms. of neem seed powder appreciably throughout the storage period than at higher concentrations and proved to be optimum dosage. However, the seed, leaves and bulb powders at higher dosage levels also exhibited substantial reductions in grain damage over controls (fig. 1a-1a). Among the dry leaf powders, neem was more effective in reducing the grain damage caused by mycoflora and pest in final obervations (36 months) showed significant difference in grain damage at different concentration levels of various treatment with their respective controls.

The treated grains, exhibited higher germination percentage with subsequent reduction in pests and mycoflora. The percentage of germination ranged between 60 to 75 in treated grains with seed powders and the untreated grains exhibited 40 germination at the end of the storage **(fig. 3a & 3d).** The grains damaged by pests and mycoflora failed to germinate and lost viability earlier in case of control than the treated ones.

Normally, concentration leads to germination losses with the increase in grain infection. The present findings are in conformity with Barrison and Perry (1979). Accordingly, the incresed fungal invasion lead to an escalating deterioration process resulting in an increased moisture content, temperature and production of toxic metabolities leading to multiplication of pests and evidently damaged the embryo effecting germinability to a greater extent.

Neergaard (1979) and Hyde (1999) also reported loss of viability of stored grains attributed the same to an increase in the rate of respiration during storage.

Germinability after treatment with leaf powder of garlic was moderate ranging between 50 to 60% **(Fig. 3g)**. A similar view has been experienced by Ramadevi *et al.*, (1988) observations. Subsequently, the germination tends to decrease with increase in infestation and infection during storage that proved to be dependent on dosages and duration. With increase in dosages, the rate of infection and infestation decresed enabling high germinability.

The promising plant meterials found in the present study have medicinal value and proven safety to people and non-target animals (Nadkarni, 1954). Hence, such plants can be safely employed in protection of stored grains and from pests and mycoflora.

Summary

The data on the efficacy of neem, karanj and fenugreek seed powders treated on grains indicated substatial reduction in pest emergence and fungal population and exhibited maximum germination at all dosages.

The neem seed powder even at lower dosage of 4 gms/250 gms of grains effectively controlled pest emergence. Howevert, the leaf powders of neem, karanj fenugreek, Eucalyptus, Mentha and bulb powder of garlic were more effective at higher concentrations. The respective controls of pests and mycoflora leading to loss in germination percent.

·I is evident from the above study that the plant product possess compounds that could be effectively used as biological control of insect pests, mycoflora. These natural 'insecticides' of plant origing are more specific, less persistent as compared to existing synthetic xenobiotic agents. Further, they neither affect germination not organoleptic properties of grains.

In view of the above, it becomes necessary to standardize the use of natural protectants.

Effect of the byproducts of indigenous plant powders on the incidence of pests on *Zea mays*

Effect of dry leaf powder of *Azadirachta indica*

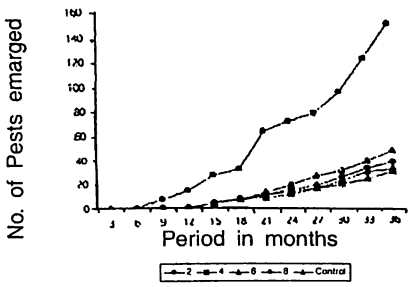

Fig.1a

Effect of Dry leaf powder of Eucalyptus citriodora

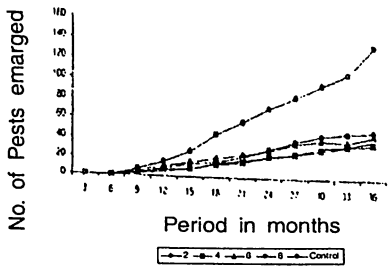

Fig.1b

Effect of Dry leaf powder of *Azadirachta indica*

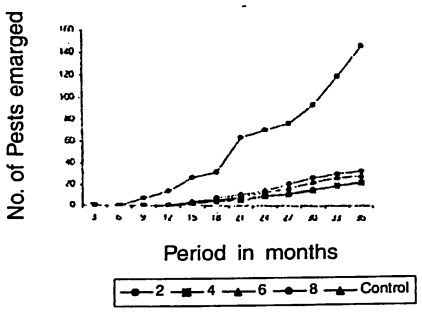

Fig.1c

Effect of Dry leaf powder of *Pongamia globra*

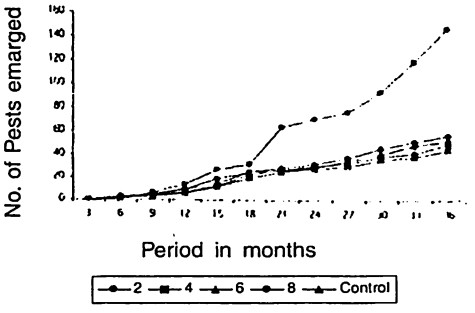

Fig.1d

Effect of Dry leaf powder of *Azadirachta indica*

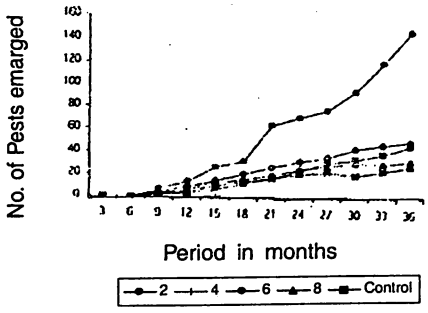

Fig.1e

Effect of Dry leaf powder of *Pongamia globra*

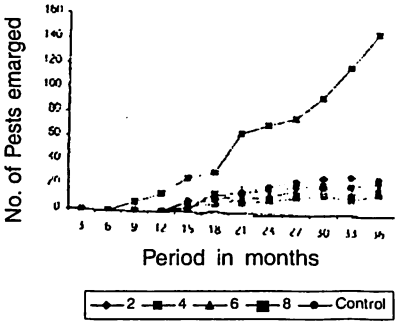

Fig.1f

Effect of Dry leaf powder of *Pongamia globra*

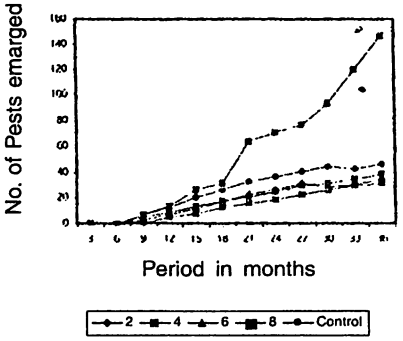

Fig.1g

Effect of the by products of the indegenous plant powders on the indidence of mycoflora on *Zea mays*

Effect of Dry leaf powder of *Azadirachta indica*

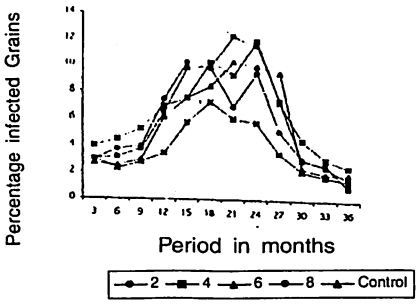

Fig. 2a

Effect of Dry leaf powder of *Azadirachta indica*

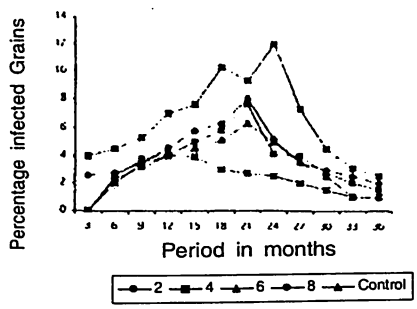

Fig. 2b

Effect of Dry leaf powder of *Pongomia glabra*

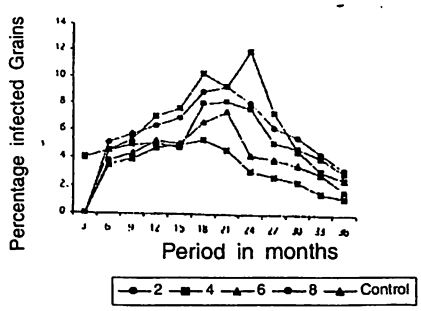

Fig. 2c

Effect of Dry leaf powder of *Eucalyptus Citridora*

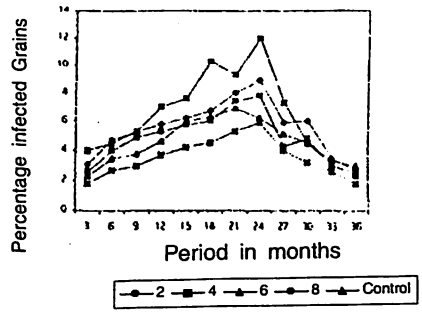

Fig. 2d

Effect of Dry leaf powder of *Eucalyptus Citridora*

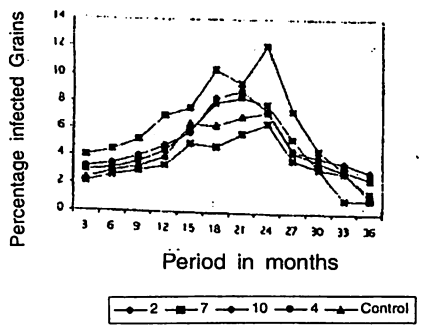

Fig. 2e

Effect of Dry leaf powder of *Eucalyptus Citridora*

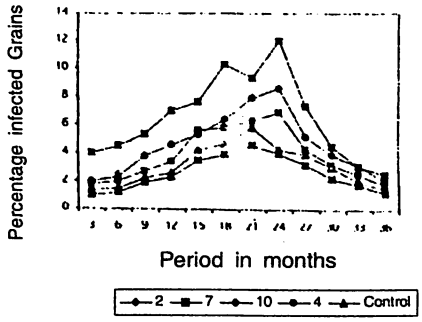

Fig. 2f

Effect of Dry leaf powder of *Eucalyptus Citridora*

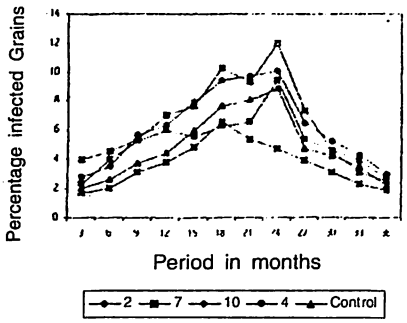

Fig. 2g

Effect of the by products of the indegenous plant powders on the germination of *Zea mays*

Effect of Dry leaf powder of *Azadirachta indica*

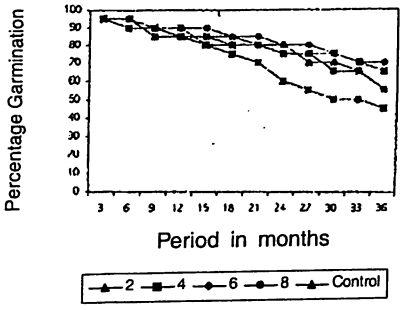

Fig. 3a

Effect of Dry leaf powder of *Azadirachta indica*

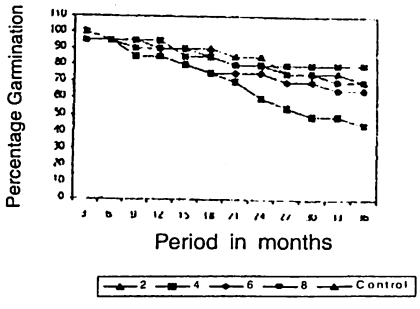

Fig. 3b

Effect of Dry leaf powder of *Pongomia globra*

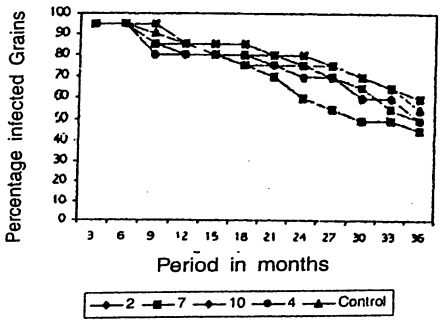

Fig. 3c

Effect of Dry leaf powder of *Eucalyptus Citridora*

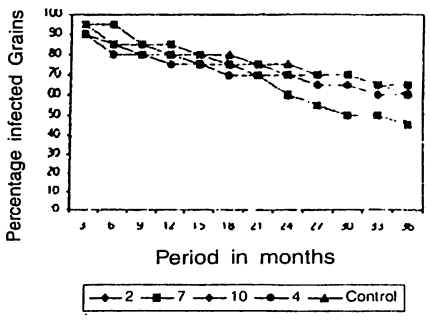

Fig. 3d

Effect of Dry leaf powder of *Mentha piperita*

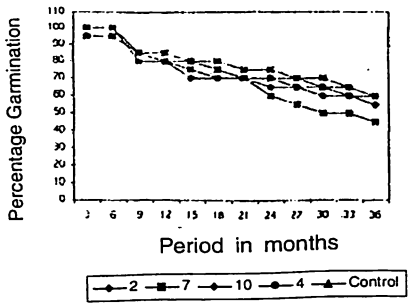

Fig. 3e

Effect of Dry leaf powder of *foenum-graecum*

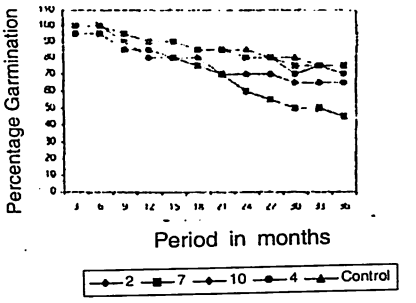

Fig. 3f

Effect of Dry leaf powder of *Allium sativum*

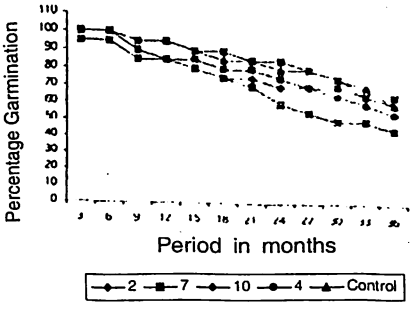

Fig. 3g

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OBITUARY

Hari Singh, the father of forest fraternity, passed away peacefully on 18th March 2003 at Bangalore, leaving behind wife Kamala, his children and their families, and a host of admirers and friends in gloom.

The entrance to the convocation hall of the Forest Research Institute and Colleges, Dehra Dun is adorned by two brass plaques with busts of Brandis and Hari Singh. Brandis set up the forest department in India. Hari Singh helped to weld the sector belonging to different states to a national whole and was largely responsible for the constitution of the Indian Forest Service. Perhaps, the most fitting tribute to Hari Singh was the two page note on his career and achievements, with a photograph, in the peer reviewed Commonwealth Forestry Review, London (Dec 1970), on his retirement as Inspector General of Forests. Its next two pages were devoted to 22 foresters from around the world. The Director General of the British Forestry Commission, on learning of Hari Singh's retirement wrote that he had imbued the forest service of India with a sense of unity and purpose. The U N D P resident representative expressed that "It is thanks to men of your calibre that India has come through this difficult period so relatively well and thus is building a solid base for future progress". Late Y. S. Rao reflected that "Hari Singh made fledgling foresters of the 1960's into high calibre professionals with standing in the field of international forestry".

Hari Singh was responsible for the shift of focus in the international field from temperate forests to tropical forests. He was the torch bearer of Indian forestry in the International level as the Chairman of the F A O Committee on Range Forest Management and Teak Sub Commission; Chairman of the Technical Commission on Forest Protection of the sixth world Forestry Congress; Chairman of the 9th Commonwealth Forestry Conference; Chairman of the joint UNCTAD and F A O session on forests, etc.,

Hari Singh as a young D F O organised the newly formed Soil Conservation Department in Bombay State. He was the first Chief Conservator of Forests of the newly formed Gujarat state in 1960. His elevation as Inspector General of Forests was through a singularly new phenomenon, in that all the Chief Conservators of the country 'electing' him to lead the sector.

Hari Singh continued to be associated with forestry and forest research institutes even after his retirement. One of his greatest contributions to the country was as Member of the National Agriculture Commission representing forestry. Promotion of forestry outside the confines of Govt. sector and facilitating funding of forestry projects through banking institutions instead of being limited to the Govt. budget were his concepts which have grown within the Country and have now spread to all the developing countries.

Hari Singh had settled in Bangalore and was always available for us for advice. A noble soul.

Forest Fraternity

MyForest, June, 2003
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EVALUATION OF SOME INSECTICIDES AGAINST LACE BUG *TINGIS BEESONI* DRAKE (HEMIPTERA:TINGITIDAE) IN THE HI-TECH PLANTATION OF *GMELINA ARBOREA* LINN.

P. B. MESHRAM*

ABSTRACT

Lace bug *Tingis beesoni* severely defoliated the plants of *Gmelina arborea* Hi-Tech. plantation. The attack is followed by fungus *Hendersonula toruloidea*. Some insecticides like larvin, caldon, decis, monocrotophos and bioneesh with a mixture of systemic fungicide carbendazim were tried against the pest disease complex during August 2002 at Poama, Chhindwara. The results revealed that the plants treated with decis 0.005% + carbendazim 0.01% followed by monocrotophos 0.075% + carbendazim 0.01% after 7 and 15 days of intervals exhibited maximum mortality of the bug as compared to control.

Introduction

Gmelina arborea Linn. a fast growing deciduous tree species of tropical and subtropical regions of India, is for reclamation of wasteland, marginal land, fallow land and also for the different programmes under social and community forestry, afforestation/reforestation for programmes. It provides raw materials for paper and matchwood industry. The wood is used in construction, furniture etc. Leaves are good fodder for cattles and all plant parts have immense value (Anon., 1952).

In Madhya Pradesh the Hi-Tech plantations of *G.arborea* is a recent approach in plantation strategy. East Forest Division Chhindwara (M.P.) had raised the Hi-Tech plantation in 1 ha. area during 1999. However, this plantation is now facing a great problem of sap sucker, lace bug *Tingis* beesoni Drake (Hemiptera: Tingitidae). The nymphs and adults of this bug feeds entirely at the base of leaf blade on the under surface and at the leaf axils. The leaf becomes spotted and brownish near the base. Affected leaves wither and plant completely defoliated. The shoot dry up, turn black and a sooty mould grows all over the plants leading to top dying and mortality. (Beeson 1941, Browne 1968 and Harsh *et al.*, 1992). Excepting this none has worked on the evaluation of some insecticides against this pest. Therefore, this study was undertaken to evalute some insecticides for the control of this pest.

* Centre for Forestry Research & H.R.D. Poama, P.O. Kundalikala, Chhindwara 480 001 M.P. India

Materials and method

The enquiry on the pest problem in the Hi-tech plantation of *Gmelina arborea* was referred by the Divisional Forest Officer, East Forest Division, Chhindwara (M.P.). To workout the evaluation of some insecticides a field trial was laid out in Hi- Tech plantation of *G. arborea* in compartment number 1275 at Poama, Chhindwara in 1 ha. area during August 2002. The spacement was 2.60 x 0.90 mt., the average height 5.5 m and girth 18 cms respectively. The trial was performed in randomized complete block design (RCBD) with four replications In all six treatments *viz* Larvin 75 w.p. 0.1% +Carbendazim 0.1%, Caldan 50 S.P. 0.1% + Carbendazim 0.1%. Decis 2.8 E.C. 0.005%+Carbendazim 0.1%, Monocrotophos 36 E.C.0.075% + Carbendazim 0.1%, Bioneesh – an indigenous neem based vermiwash (*i.e.* earthworms + neem leaves + cow's urine) pure and untreated control were used. Pre-treatment observation in respect of bug population in all plants were recorded. The different concentrations of insecticides (**Table-1**) were prepared by diluting them with water on the basis of their active ingredients. Ten litre solution of the insecticides were uniformly sprayed up to run off stage per replication. Post treatment observations were recorded after 7 and 15 days of interval. Incidence of bug population was recorded randomly on 25 plants by numerical counts on both sides of leaves. Ten leaves were randomly selected from each direction. The data obtained on percentage of reduction in population were compiled and subjected to pooled analysis after transformation as given by Bliss (Snedecor, 1959).

Results and discussion

The pooled average bug population recorded after 7 and 15 days from application revealed that the results of all treatments were significantly superior to those of the control in reducing the population of bug *T. beesoni.* Decis 0.005% + Carbendazim 0.1% and Monocrotophos 0.075%+ Carbendazim 0.1% proved highly effective by reducing 96.00 and 94.35 per cent population of bug compared with 23.98 per cent in the untreated control. Among others Caldan 0.1% + Carbendazim 0.1% and Larvin 0.15% + Carbendazim 0.1% gave minimum bug population upto 86.33 and 83.28 espectively. Bioneesh an indigenous neem leaf extract through vermiwash was moderately effective recording 40.75% reduction in bug population. Harsh *et.al.*, (1992) only suggested that the infection can be controlled by spraying on the crown and stem of affected trees with a moxture pesticide Monocrotophos 0.02% + systemic fungicide Bavistin 0.1% against the pest disease complex soon after the onset of monsoon rains.

Thus, it could be concluded that the only highly effective insecticide proved best are Decis 0.005% + Carbndazim 0.1% and Monocrotophos 0.075% + Carbendazim 0.1%. The latter is less coster than Decis and therefore recommended for control of this pest. If Decis is not available Monocrotophos can be used.

Acknowledgement

The authour is thankful to Shri A.K. Patra, IFS, Conservator of Forests & Head, Centre for Forestry Research & Human Resource Development, Chhindwara and Divisional Forest Officer, East Forest Division, Chhindwara for providing the necessary facilities.

Table 1 – Average bug population reduction (%) after treatment

Treatment	Dosage per treatment	Reduction% bug Population after		Pooled average % reduction in Population
		7 days	15 days	
T_1. Larvin 75 W.P. 0.1%	2.0 ml	83.60	82.96	83.28
T_2. Caldon 50 S.P. 0.1%	2.0 ml	89.00	83.67	86.33
T_3. Decis 2.8 e.c. 0.005%	1.8 ml	94.22	97.80	96.01
T_4. Monocrotophos 36 E.C. 0.075%	2.0 ml	93.77	94.93	94.35
T_5. Bioneesh pure	–	38.01	43.50	40.75
T_6. Control (untreated)	–	26.20	21.76	23.98
SE m + ----------	----------	3.80	2.35	3.17
CD at 5% ----------	----------	13.79	6.11	7.84

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GOVERNMENT OF KARNATAKA

No. DPAR 1 SFP 2003 (3)

Karnataka Government Secretariat
Vidhana Soudha, Bangalore

Dated 24th April, 2003

NOTIFICATION

The services of Shri M. N. Jayakumar, IFS (KN 79), Conservator of Forests, Mysore Circle, Mysore, are placed at the disposal of Commerce and Industries Department with immediate effect and until further orders for posting him as Conservator of Forests & Director (Forests), Mysore Paper Mills Ltd., Bhadravathi, vice Shri M.R. Karki, IFS, transferred.

The services of Shri M. R. Karki, IFS (KN 80), Conservator of Forests and Director (Forests), Mysore Paper Mills Ltd., Bhadravathi, are withdrawn from the Commerce and Industries Department with immediate effect and he is posted until further orders as Conservator of Forests, Mysore Circle, Mysore, vice Shri M.N. Jayakumar, IFS, transferred.

Shri P. Anur Reddy, IFS (KN 82), Conservator of Forests, Kodagu Circle, Madikeri, is transferred with immediate effect and posted until further orders as Conservator of Forests, PP & M Unit, ODA, Western Ghat Forestry & Enviornment Project, Bangalore, in the existing vacancy.

The Services of Shri C. Venkatasubbaiah, IFS (KN 83), Conservator of Forests & General manager, Karnataka State Forest Industries Corporation Ltd., Bangalore, are withdrawn from the Forest, Ecology & Environment Department with immediate effect and he is posted until further orders as Conservator of Forests, Kodagu Circle, Madikeri, vice Shri P. Anur Reddy, IFS, transferred.

Shri M.V. Krishne Gowda, IFS (KN 85), Silviculturist, South Zone, Madikeri, is promoted to officiate in the rank of Conservator of Forests, carrying the Super Time Pay scale (Level 2) of IFS i.e., Rs. 16,400-450-20,000, with immediate effect and his services are placed at the disposal of Forests, Ecology & Enviroment Department until further orders for posting him as Conservator of Forests and General Manager, Karnataka State Forests Industries Corporation Ltd., Bangalore, vice Shri Venkatasubbaiah, IFS, transferred.

By order and in the name of the
Governer of Karnataka

(B. V. Kumarawamy)
under Secretary to Government
D.P. & A.R.(Servies-I)

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INFLUENCE OF THE DIFFERENT VA MYCORRHIZAL ISOLATES ON GROWTH AND NUTRITION OF SANDALWOOD PLANTS

G. MAMATHA, M.S. SHIVAYOGI, D.J. BHAGYARAJ and C.K. SURESH*

ABSTRACT

In order to study the response of sandal wood plants to VA mycorrhiza, different strains of *Glomus* were isolated from different agro-climatic zones of Karnataka where sandal is distributed. These VAM spores were identified, mass multiplied, and tested on sandal seedlings. Various parameters like plant height, number of leaves, dry biomass, phosphorus content, soil microbial count and soil enzyme activity were recorded. It was observed that among all the isolates tested the standard isolate, *Glomus fasciculatum* was very efficient in increasing the biomass as well as the other parameters. However, all the isolates performed better than the uninoculated plants.

Key words: agroclimatic zones, enzyme activity, *Glomus*, growth, sandalwood

Introduction

Sandal (*Santalum album* L.) belongs to the family santalaceae. It is widely distributed in India, Indonesia and parts of Malaysia, Australia, New Zealand and Polynesia extending upto Hawaiian Archipelago. In India, though it occurs all over the country, more commonly it occurs in Karnataka and Tamil Nadu. Sandalwood is known to grow well on a variety of soils like and, clay, red soils, laterite loam, black cotton soils as also in red ferruginous loam with varying fertility. The trees are root parasites of grasses, herbs, shrubs or trees. Oil obtained from sandal are used in incense, perfumes, medicine and wood for carving (Srinivasan *et al.*, 1992).

Mycorrhizal fungi are ubiquitous soil microorganisms exhibiting symbiotic relationship with roots of most of the terrestrial plants and also a few aquatic plant species. Tropical regions are dominated by soils that are low in available nutrients and moisture (Osonubi *et al.*,1991). Therefore, any factor, e.g., VAM fungi which help plants in better utilization of soil phosphorus (Gianninazzi-Pearson & Gianninazzi, 1989); protection from detrimental effect of root pathogens (Suresh & Bagyaraj 1984) and provides resistance against drought contributes to the success of plant establishment and survival. There has been a considerable interest in the possible utilization of VAM in forest tree species, we need to understand their ecology in forests

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with established vegetation. This is because revegetated soils may prove to be valuable sources of inoculum of adapted strains. Hence, the present study was taken up to study the effect of VAM isolates from different agro-climatic zones of Karnataka where sandal is distributed along with a standard culture, *G. fasciculatum* and uninoculated control.

Materials and method

Sandalwood rhizosphere soil samples were collected from 2 to 3 locations of seven different *agro-climatic* zones of Karnataka such as, central dry zone (red sandy loam with higher amount of sand and pH values of soil slightly alkaline in reaction and increased with depth from 7.71 to 8.84), eastern dry zone (sandy clay loam in the first two horizons and changed to sandy clay and clay in the subsequent horizons with pH slightly acidic and it increased from 5.41 to 6.21 with depth), southern dry zone (sandy clay loam) southern transition zone (red loam and red sandy loam), northern transition zone (shallow to medium black clay and sandy loam), hilly zone (red clay loam) and coastal zone (red lateritic and coastal alluvial).

Seeds of sandal were surface sterilized with 70% alcohol for 10 minutes, washed thoroughly with water, soaked overnight and sown in boxes of dimension 50x27x22 cm containing sand: soil (2:1) mix. Watering was done at regular intervals. The soil used in this study was surface soil collected from a depth of 0 to 15 cm from the University Campus. The soil is classified as fine, kaolinitic, isohypothermic, Kanhaplustalfs with pH of 5.6, organic carbon of 0.56%, available nitrogen of 238 kg/ha, available phosphorus of 25 kg/ha and available potassium of 30 kg/ha. The seedlings were allowed to grow for a month in the battery boxes. Thirty days old seedlings were transplanted to the pots containing 3.75 kg unsterilized sand: soil (1:2) and 20g of compost. Lantana was used as host. The pots containing the plants were arranged on green house benches in complete randomised (CRD) design using random numbers and the position of the pots were changed once in a month to minimize experimental errors due to positional effect. The seven different agro-climatic zones Isolates were named from Isolate II to Isolate VIII. Treatments were Isolate I (*G fasciculatum*-Standard culture); Isolate II (*G. hoi* from central dry zone); Isolate III (*G. mosseae* from eastern dry zone); Isolate IV (*G. caledonlum* from southern dry zone); Isolate V (*G. deserticola* from southern transition zone); Isolate VI (*G. etunicatum* from northern transition zone); Isolate VII (*G. fulvum* from hilly zone); Isolate VIII (*G.clarum* from coastal zone); Uninoculated control.

VAM spores that were dominant were isolated from seven agro-climatic zones of Karnataka. For assessment of the occurrence of spores in the rhizosphere, the soil was subjected to the wet sieving and decanting method (Gerdemann and Nicolson 1963). The distinct morphological types of mycorrhizal spore isolated from the root zone soil of sandal were sterilized using 200 ppm of streptomycin sulphate (5 minutes) and 0.2% of chloramine T (5 minutes). A single spore was placed at the bottom of a glass funnel on which sterile sand: soil (1.1 v/v) mix was added. The stem of funnel was plugged with cotton, dipped in sterile water kept in a test tube, and planted with surface sterilized sorghum (Nicolson 1957). The plants were in the funnel for six weeks and then transferred to pots containing sterilized 1:1 and:soil mixes and maintained in a glass house. The VAM cultures from these were

further multipled by adding these substrates into many pots, containing 1:1 sand soil mix and planting Rhodes grass (*Chloris gayana*) as host. These VAM isolates thus maintained in the glass house were reisolated through wet sieving and decantation method.

The pots were inoculated with different isolates along with standard culture, *G. fasciculatum* and uninoculated control and the sandalwood plants were transplanted. Growth parameters like, plant height and number of leaves were recorded at 30 days interval for one year. The plants were harvested after one year of transplanting. The roots were depotted and washed. After taking fresh weight of shoot and root samples both were individually dried in hot air oven at 60°c to attain a constant weight to determine the plant biomass. Phosphorus content of the plant (Root+shoot) was estimated by vanadomolybdate yellow colour method (Jackson 1973).

Mycorrhizal root colonization was determined after the roots were freed from the adhering soil. The roots were gently washed and then cut into 1 cm segments. The degree of colonization was calculated by using the gridline intersect method (Giovanetti and Mosse 1980). The colonization was determined after clearing the roots with 10% KOH and staining with acid fuchsin in lacto glycerol (Phillips and Hayman 1970).

The soil samples were collected from the root zone and analyzed for different microbial population and enzymatic activities (*viz.*, acid-, alkaline- phosphatase and dehydrogenase). Enumeration of the soil microorganisms was done by dilution plate method using nutrient agar for bacteria, potato dextrose agar for fungi, Kuster's agar for actinomycetes and Waksmann-77 for *Azotobacter* and the results were expressed in colony forming units (cfu) per gram of the soil sample (Seeley and Van Demark 1975). Enzyme activities like acid phosphatase, alkaline phosphatase and dehydrogenase of soil were assayed according to Eivazi and Tabatabai (1977). Acid and alkaline phosphatase of soil was measured by using P-nitrophenyl phosphate prepared at two pH 6.5 and 11 for acid phosphatase and alkaline phosphatase respectively as a substrate. The yellow color complex was measured using 1 cm cuvette in the spectrophotometer (Shimadzu UV-visible) at 420 nm. The amount of P-nitrophenol released was calculated by referring to a calibration graph. Results were expressed as microgram P-nitrophenol (PNP) per gram of soil per hour. Dehydrogenase activity of soil was determined by 2, 3, 5 triphenyl tetrazolium chloride (TTC) reduction technique. Results were expressed as microgram triphenyl formazon (TPF) per gram of soil per hour (Eivazi and Tabatabai 1977).

Phosphorus content of the plant (root+ shoot) was estimated by vanadomolybdate yellow colour method (Jackson 1973). The data collected in this study was subjected to statistical analysis suitable to CRD Duncan's multiple range test was done to separate the means (Little and Hills 1978).

Result and discussion

Inoculation of sandalwood plants with VAM fungi significantly improved plant growth and nutrition compared to the uninoculated plants. Plant height and number of leaves were significantly higher in plants grown in

soil inoculated with standard culture of VAM fungi, *G. fasciculatum.* Least plant height and number of leaves were observed in uninoculated control plants **(Table 1).** Total biomass (shoot+root) and P content of sandalwood was significantly more in plants inoculated with standard culture of VAM fungi, i. e. *G. fasciculatum.* Total biomass and P content was significantly lower in uninoculated control **(Table 2).** This indicates that there is a direct correlation between plant biomass and P uptake. Similarly, the per cent rot colonization and spore number, in the root zone soil of *G. fasciculatum* inoculated plants was significantly higher compared to other treatments. This upholds the view of Reena and Bagyaraj (1990) in their studies with *Calliandra calothyrsus* inculcated with 13 different VAM fungi and Sumana and Bhagyaraj (1993) in their investigations on the influence of 13 different VAM fungi in *Azadirachta indica,* who observed improved plant growth, higher biomass, significantly higher phosphorus content when inoculated with *G. fasciculatum.* This improvement was attributed to increased surface area of absorption due to exploration by the external hyphae of the soil beyond the root hair zone (Gerdemann 1975).

Enzyme activities *viz.* acid-, alkaline phosphatase and dehydrogenase were significantly higher in rhizosphere soil inoculated with standard culture, *G. fasciculatum* followed by our isolate from southern transition zone (*G. deserticola*) (Zone VII). Acid and alkaline phosphatase was significantly lower in uninoculated control **(Table 3).** Among the microbial population observed, maximum bacterial and fungal population was observed in plants grown in soil inoculated with standard culture of *G. fasciculatum* while actinomycetes population did not differ significantly among different treatments **(Table 4).** The pot culture studies on the effect of inoculation of *G. fasciculatum* on sandalwood plants revealed that there was a positive correlation between microbial population and enzymatic activity. Dehydrogenase activity has been commonly used as an indicator of biological activity in soils because the biochemical properties of this enzyme are such that free dehydrogenases in soil are not expected (Frankenberger & Dick 1983). A positive correlation between dehydrogenase activity and microbial activity has been reported by many workers (Skujins 1973; Frankenberger & Dick, 1983). The relationships that exist between the various soil enzyme activities and microbial numbers were evaluated and this can be significantly correlated with microbial numbers as obtained by plate counts on various selected media. Many investigators have attempted to relate enzyme activity to microbial numbers in soils with varying results (Skujins, 1967). Both the microorganisms and plants release enzymes into the environment (Juma & Tabatabai, 1988). Acid phosphatase from the surface of roots hydrolyze organic phosphate and release inorganic phosphates and that this activity was many times higher in roots colonized by mycorrhizal fungi (Ho & Zak, 1979). Alkaline phosphatase activity is believed to be entirely derived from the microbial population in soils; no activity was observed in corn, soybeans, oats, or alfalfa whole plants (Dick & Tabatabai 1983).

It is quite interesting (evident) to know that the mycorrhizal fungi interact with a wide range of other soil microorganisms in the root, rhizosphere, mycorrhizosphere and in the bulk soil. These interactions, with specific functional capabilities such as inhibitory or stimulatory, competitive or mutualistic may influence plant growth (Lindermann 1988, Fitter and Garbaye 1994). Bansel and Mukerji (1994) established a

correlation between VAM induced changes in root exudation and mycorrhizosphere mycoflora and indicated that the presence of specific mycoflora in the rhizosphere was medicated through root exudates rather than being an outcome of improved nutrition alone. The microbial communities in the mycorrhizosphere actively interact with the establishment and functioning of the mycorrhizal symbiosis (Garbaye 1991).

In recent years many high value plants like sandal are in great demand for their economically important values. From the results of the present study it is evident that it is important to inoculate the rhizosphere soil with *G. fasciculatum* to harness the beneficial effect in terms of improving their growth, establishment and nutrition of sandalwood plants.

Acknowledgements

We would like to thank the Department of Science and Technology- New Delhi, for providing funds and Karnataka State Forest Department for their co-operation in carrying out this research.

Table 1 – Effects of soil inoculation of standard culture of vam and its isolates from seven agro-climatic Zones of Karnataka on plant height, number of leaves (at harvest) and dry biomass of sandalwood plants in pot culture.

Isolates*	Plant Height cm	Number of leaves	Dry biomass (g)		
			Shoot	Root	Total
Isolate I**	37.63	38.33	5.49	3.06	8.55
Isolate II	31.77	31.67	4.82	2.02	6.84
Isolate III	32.10	33.33	5.02	2.29	7.31
Isolate IV	31.90	30.00	4.69	2.28	6.97
Isolate V	35.03	36.00	5.04	2.59	7.64
Isolate VI	33.80	34.67	4.96	2.45	7.41
Isolate VII	31.93	32.67	4.78	2.40	7.18
Isolate VIII	31.07	30.67	4.56	2.07	6.64
Control	28.70	28.33	4.12	1.59	5.71
F- Test	*	*	*	*	*
LSD Value	1.96	2.58	0.67	0.27	0.50

* Isolate-details given in text
** Isolate I: Standard culture – *G. fasciculatum*

Table 2 – Effect of soil inoculation of standard culture of VAM and its isolates from seven agro-climatic zones of Karnataka on shoot and root P content, per cent mycorrhizal root colonization, spore count of rhizosphere soil of sandalwood plants in pot culture.

Isolate*	P content (mg/plant)		Mycorrhizal root colonization (%)	Spore count/ 50 g soil
	Shoot	Root		
Isolate I**	22.10	9.09	48.67	169.67
Isolate II	17.83	5.05	37.33	136.67
Isolate III	19.24	5.57	29.67	145.00
Isolate IV	17.69	5.98	36.00	137.33
Isolate V	21.36	6.40	41.00	150.00
Isolate VI	20.35	5.95	38.00	160.33
IsolateVII	18.71	6.16	32.67	144.33
Isolate VIII	15.66	4.78	25.67	129.33
Control	12.64	3.12	18.00	108.33
F-Test	*	*	*	*
LSD Value	2.416	0.765	7.77	37.35

* Isolate-details given in text

* Isolate I: Standard culture – *G. fasciculatum*

Table 3 – Effect of soil inoculation of standard culture of VAM and its isolates from seven agro-climatic zones of Karnataka on acid phosphatase, alkaline phosphatase and dehydrogenase activity of root zone soil of sandalwood plants in pot culture.

Isolate	Acid phosphatase activity (µg/g soil)	Alkaline phosphatase activity (µg/g soil)	Dehydrogenase activity (µg/g soil)
Isolate I*	96.05	49.49	562.50
Isolate II**	66.26	29.28	349.01
Isolate III	71.35	33.66	463.86
Isolate IV	62.13	36.92	413.16

Isolate	Acid phosphatase activity (ug/g soil)	Alkaline Phosphatase activity (ug/g soil)	Dehydrogenase acivity (ug/g soil)
Isolate V	94.65	45.92	504.98
Isolate VI	86.25	46.51	513.44
IsolateVII	91.54	41.58	438.86
Isolate VIII	55.82	46.85	397.79
Control	50.20	27.48	347.84
F-Test	*	*	*
LSD Value	7.39	10.32	33.40

* Isolate-details given in text

** Isolate I: Standard culture – *G.fasciculatum*

Table 4 – Effect of standard culture of VAM and its isolates from seven agro-climatic zones of Karnataka on microbial population of rhizosphere soil of sandalwood plants in pot culture

Isolate*	Bacteria $x10^4$	Fungi $x10^3$	Actinomycetes $x10^2$	Azotobacter $x10^2$
Isolate I**	57.67	10.00	15.33	14.33
Isolate II	9.00	3.33	12.00	9.67
Isolate III	28.00	4.00	16.33	6.67
Isolate IV	14.33	5.00	13.00	7.33
Isolate V	28.67	8.00	13.33	8.67
IsolateVI	35.33	4.33	11.67	8.67
IsolateVII	16.00	3.00	14.00	7.00
IsolateVIII	8.67	2.33	14.33	5.00
Control	9.33	2.67	12.67	6.67
F-Test	*	*	NS	*
LSD value	9.24	3.63	–	5.03

* Isolate-details given in text

** Isolate I: Standard culture – *G. fasciculatum*

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GOVERNMENT OF KARNATAKA

No DPAR 49 SFP 2002

Karnataka Government Secretariat,
Vidhana Soudha, Bangalore

Dated 17th April, 2003

NOTIFICATION

Shri S.K. Chakrabarti, IFS (KN 68), Principal Chief Conservator of Forests (Wildlife) and Chief Wildlife Warden, Bangalore, is transferred with immediate effect and posted until further orders as Principal Chief Conservator of Forests, (Evaluation, Working Plan, Research & Training), Bangalore, in the existing vacancy.

Shri Ram Mohan Ray, IFS (KN 70), waiting for posting, is posted with immediate effect and until further orders as Principal Chief Conservator of Forests (Wildlife) and Chief Wildlife Warden, Bangalore, vice Shri S.K.Chakrabarthi, IFS, transferred.

BY ORDER AND IN THE NAME OF THE
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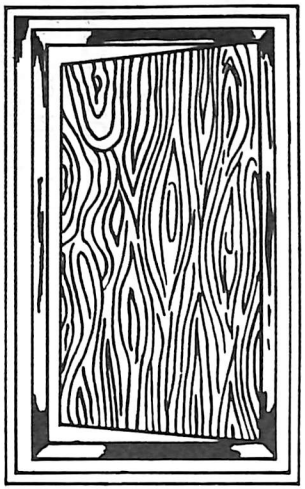

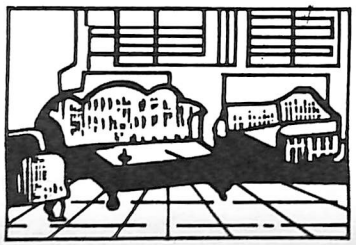

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ASSOCIATION STUDIES FOR NURSERY GROWTH PARAMETERS IN *ALBIZIA LEBBECK* (L.) BENTH.

S. RADHAKRISHNAN[1] and K. VANANGAMUDI[2]

ABSTRACT

The correlation and path coefficient analysis was conducted in six months old nursery seedlings of *Albizia lebbeck* consisted of thirty seed sources. In general, genotypic correlations were higher than phenotypic correlations for all the characters except root fresh and dry weights which were strongly associated with volume both at genotypic and phenotypic levels. Shoot length expressed maximum direct effect followed by collar diameter. Shoot fresh weight exhibited maximum indirect effect via shoot length on volume.

Key words : *Albizia lebbeck*, correlation, path coefficient analysis, seedling growth attributes

Introduction

Siris (*Albizia lebbeck* (L.) Benth.) is one of the important multipurpose leguminous tree, known for its adaptive and economic traits. The tree is found all over the India and extensively cultivated in avenues and gardens. Siris had gained considerable importance in agroforestry and afforestation activities due to its fast growth and multifarious utility. Genetic improvement of forest trees is the need of the hour to meet the growing demand of forest products. Selection is the most important activity in all tree breeding programmes. Tree yield '*ie*' tree volume is a complex and highly variable character which is influenced by many component characters. For provenance trails, it is essential to know the magnitude and type of association between growth and its component characters. Knowledge on association among components of economic importance can help in improving the efficiency of selection. In the integrated structure of the plant, the overall correlation observed between two variables is a function of a series of direct and indirect relationship between different variables. To understand the specific forces in building up the total correlation, it is essential to resort through path coefficient analysis, which gives an insight into a complex relationships between different characters in a biological systems. Further, path coefficient analysis measures the direct influence of one variable upon another and permits the separation of correlation coefficients into components of direct and indirect effects (Wright 1921).

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Studies on this aspects in *Albizia lebbeck* is very limited. Hence, this study is undertaken to workout the correlation and path analysis in *Albizia lebbeck*.

Materials and method

Seeds of *Albizia lebbeck* were colle cted from thirty different seed sources covering its wide range of geographical distribution comprising seven states of India **(Table 1).** The seeds from all seed sources were scarified using commercial grade sulphuric acid @ 60 ml per 100 g of seeds for 20 min. and washed thoroughly with running tap water. The seeds were sown in nursery polythene bag of size 20cm x 15cm containing a mixture of soil, sand and farmyard manure (3:1:1). The experiment was set up in CRD with four replications. The observations on root length (cm) shoot length (cm), collar diameter (cm), number of leaves, fresh and dry weights of root and shoot and volume index were recorded for twenty randomly selected seedling at six months after sowing. The data were subjected to statistical analysis. Genotypic and phenotypic correlations were calculated according to the method suggested by Goulden (1952). Path coefficient analysis was estimated following by Dewey and Le (1959).

Results and discussion

In general the genotypic correlation values were higher than phenotypic correlation values **(Table 2** and **3).** This suggests that there is a strong inherent association between pairs of various characters and confirming the earlier reports (Chauhan and Verma 1993). Volume index of seedlings exhibited highly significant and positive association with shoot (0.827, 0.825) and root lengths (0.568, 0.671), shoot fresh (0.730, 0.728) and dry weights (0.586, 0.583) at both genotypic and phenotypic levels. Similar results of highly significant and positive correlation of volume with seedling parameters in *Tectona grandins* (Arunprasad, 1996), gbh and plant height in *Eucalyptus* spp (Paramathma and Surendran, 1997), basal diameter, plant height and leaf breadth in *Santalum album* (Reddy and Subramaniam, 1998) were also reported. Shoot length exhibited a positive and significant correlation with number of leaves, shoot fresh and dry weights. The results agree with the findings of significant and positive association of shoot length with number of leaves in Acacia catechu (Chauhan and Verma, 1993), with leaf yield in ***Grewia optiva*** (Tikader and Roy, 1995), and with dry weight in Azadirachta indica Jidal *et al.*, 1997). From this, it is inferred that shoot length and collar diameter exhibited high values of significant positive correlations with volume both genotypically and phenotypically, which could be considered as a selection criteria to improve the productivity.

Simple correlation measures only mutual interrelationship between characters, whereas path coefficient analysis reveals specific forces in the build up of a given correlation. The direct and indirect effects of various traits on volume is furnished in **Table 4** and **Fig. 1.** Shoot length (0.681) and collar diameter (0.459) registered maximum direct positive effect on volume suggesting a better scope for improvement of volume by selecting these traits. This was followed by root and shoot fresh weight, number of leaves and root dry weight. Similar positive direct effect of shoot length followed by collar diameter on volume in Acacia nilotica (Jayaprakash 2000), shoot length on biomass in Azadirachta indica. (Jindal *et al.*, 1997) and collar diameter on volume in Santalum album (Reddy and Subramaniam, 1998) were also reported. The

characters like shoot dry weight and root length had a negative direct influence on volume.

Shoot fresh weight exhibited a maximum positive indirect effect (0.426) followed by number of leaves, and root fresh weight on volume via shoot length. Shoot length, collar diameter, number of leaves and shoot fresh weight had a negative effect on volume via root length and shoot dry weight.

In the present study, shoot length registered a maximum direct effect. Thus correlation and path analysis revealed that shoot length and collar diameter are highly associated with volume and could serve as a selection criteria reliably to increase the volume and finally the productivity in Albizia lebbeck.

Table 1 – Geographic details of the seed sources

S.No.	Location	State	Latitude	Longitude
1	Khankra	Uttaranchal	30°10'N	78°48'E
2	Rampurmandi	Uttar Pradesh	29°48'N	77°26'E
3	Fathepur	Uttar Pradesh	25°55'N	80°48'E
4	Nazeebabad	Uttar Pradesh	29°36'N	78°20'E
5	Augustimuni	Uttaranchal	30°16'N	78°58'E
6	Afjalgarh	Uttar Pradesh	29°23'N	78°40'E
7	Laachiwala	Uttaranchal	30°12'N	78°08'E
8	Gaucher	Uttaranchal	30°23'N	79°22'E
9	Ningoan	Uttar Pradesh	30°43'N	78°25'E
10	Khalgarh	Uttaranchal	29°28'N	78°28'E
11	Bhagwala	Uttaranchal	27°03'N	83°42'E
12	Badapur	Uttar Pradesh	25°52'N	82°26'E
13	Avikanagar	Rajasthan	27°17'N	75°22'E
14	Bilaspur	Himachal Pradesh	31°19'N	76°45'E
15	Haldwani	Uttaranchal	29°12'N	79°31'E
16	Doiwala	Uttaranchal	30°10'N	78°06'E
17	Gudag	Karnataka	15°25'N	75°37'E
18	Mettupalayam	Tamil Nadu	11°18'N	76°55'E
19	Coimbatore	Tamil Nadu	10°59'N	76°59'E
20	Neyveli	Tamil Nadu	11°32'N	79°27'E
21	Vellore	Tamil Nadu	12°54'N	79°07'E
22	Pudukkottai	Tamil Nadu	10°22'N	78°49'E
23	Salem	Tamil Nadu	11°39'N	78°09'E
24	Ramanathapuram	Tamil Nadu	9°21'N	78°50'E

S.No.	Location	State	Latitude	Longitude
25	Rakhdianser	Jammu and Kashmir	33°27'N	76°53'E
26	Varanasi	Uttar Pradesh	25°18'N	83°00'E
27	Palampur	Himachal Pradesh	32°05'N	76°32'E
28	Hamirpur	Himachal Pradesh	32°00'N	76°12'E
29	Solan	Himachal Pradesh	30°58'N	77°03'E
30	HP seed zone 4	Himachal Pradesh	-	-

Table 2 – Genotypic and phenotypic correlation among seedling growth attributes in *Albizia lebbeck* under nursery conditions

Characters		Root length	Shoot length	Collar diameter	Number of leaves	Root fresh weight	Shoort fresh weight	Root dry weight	Shoot dry weight	Volume
Root length	1	1.000	0.477**	0.442**	-0.446*	-0.026	0.572**	-0.018	0.558**	0.568**
	2	1.000	0.473**	0.438*	0.445*	-0.028	0.570**	-0.018	0.557**	0.557**
Shoort length	1		1.000	0.351	0.545**	-0.517	0.625**	-0.534	0.621**	0.827**
	2		1.000	0.349*	0.543**	-0.508	0.622**	-0.530	0.618**	0.825**
Collar diameter	1			1.000	0.604**	0.261	0.540**	0.272	0.336	0.793**
	2			1.000	0.601**	0.262	0.537**	0.272	0.334	0.791**
Number of leaves	1				1.000	-0.388	0.463**	0.364	0.441*	0.675**
	2				1.000	-0.386	0.463**	0.363	0.440*	0.671**
Root fresh weight	1					1.000	-0.053	0.978**	-0.216	-0.125
	2					1.000	-0.053	0.974**	-0.215	-0.117
Shoot fresh weight	1						1.000	-0.025	0.839**	0.730**
	2						1.000	-0.025	0.838**	0.726**
Root dry weight	1							1.000	-0.190	0.131**
	2							1.000	-0.190	0.128**
Shoot dry weight	1								1.000	0.586**
	2								1.000	0.583**
Volume	1									1.000
	2									1.000

1. Genotypic correlation coefficient

2. Phenotypic correlation coefficient

* – Significant at 5% level

** – Significant at 1% level

Table 3 – Path coefficient analysis showing direct and indirect effects of seedling growth attributes on volume index under nursery conditions in *Albizia lebbeck*

Characters	Root length	Shoot length	Collar diameter	Number of leaves	Root fresh weight	Shoort fresh weight	Root dry weight	Shoot dry weight	'r' with germination (%)
Root length	**-0.005**	0.325	0.203	0.028	-0.003	-0.053	0.000	-0.038	0.557
Shoot length	-0.002	**0.681**	0.161	0.034	-0.051	0.058	-0.012	-0.042	0.825
Collar diameter	-0.002	0.239	**0.459**	0.037	0.026	0.051	0.006	-0.023	0.791
Number of leaves	-0.002	0.371	0.277	**0.062**	-0.039	0.043	-0.008	-0.030	0.671
Root fresh weight	0.000	0.352	0.210	0.024	**0.099**	0.005	0.022	0.015	0.117
Shoot fresh weight	-0.003	0.426	0.248	0.029	-0.005	**0.094**	-0.001	-0.057	0.726
Root dry weight	0.000	-0.363	0.125	-0.022	0.097	0.002	**0.022**	0.013	-0.128
Shoot dry weight	-0.003	0.423	0.154	0.027	-0.027	0.078	-0.004	**-0.068**	0.583

Residual effect 0.0217

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EFFECT OF FERTILIZERS ON THE SEEDLING GROWTH OF TEAK

SIDDAPPA KANNUR[1] AND DEVAR, K. V.[2]

ABSTRACT

A nursery experiment was conducted at the Silviculture Nursery, College of Forestry, Sirsi, Karnataka, during 2000 to 2001 in order to study the effect of varying levels of nitrogen (N) on the growth and dry matter production of teak stumps. Application of one gram of N per polythene bag in two equal splits increased the growth and biomass attributes thereby reducing the nursery period required to achieve plantable seedling size.

Key words : Nursery, fertilizers, stumps, biomass.

Introduction

Standardization of nursery techniques for the production of healthy planting stock is one of the important aspects of nursery management. Nursery studies on seed germination, optimum size of the planting stock, components of soil medium and its nutrient status play an important role in the success of plantation at field level.

Application of fertilizers at the seedling stage helps in production of healthy growth and sturdy root system capable of growing in the field conditions. Fertilizer dose and time of application vary with species due to wide difference in their nutrient requirements under prevailing levels of soil fertility. Though tree requires all the essential elements, three major elements namely, N, P and K are of primary importance as they play significant role in boosting the growth and development of seedlings. Many workers have studied the role of fertilizers on seedling growth of teak and found that requirement varies with the type of the soil medium used (Bhatnagar, *et al.*, 1969, Totey *et al.*, 1986, Rangswamy *et al.*, 1990, Kalpana Mishra, 1995).

Teak (*Tectona grandis* Linn. f.) is the best timber available in India. It enjoys a place of pride amongst the timbers all over the world. Due to a rare combination of its physical and mechanical properties of the wood and other uses and hence it is imperative to develop its effective management strategies. In view of this, an investigation was undertaken to screen suitable dose of nitrogen for the production of healthy planting stock within a reasonable time through stumps.

Materials and method

The study was conducted at the Silviculture Nursery, College of Forestry, Sirsi, Karnataka during 2000-2001. Eight-month-old seedlings raised in nursery beds were used for the preparation of stump of sizes 1-2 cm

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of collar diameter with 2 cm of shoot and 15 cm root length. Stumps were planted in the polythene bags of 25 x 15 cm containing soil medium consisting of soil, sand and FYM in a ratio of 1:1:2. The experiment was replicated four times with 40 polythene bags, thereby 10 polythene bags per treatment laid in completely randomized design. Six treatments given including control as shown in the **Table 1**. Fertilizers were applied in the form of urea (46% N), rock phosphate (20% P_2O_5) and Murata of potash (60% K_2O). The dose of nitrogen was applied in two equal splits. Half of the dose was applied after one month and remaining half, after three months of planting stumps in polybags. The dose of phosphorus and potassium were applied in a single dose after one month of stump planting. Watering was carried out daily. Necessary plant protection measures were adopted. Coppice production of stumps was evaluated after 45 days of planting. The excess coppices were then removed leaving one healthy shoot. The measurement of height, collar diameter, number of leaves, root length, number of lateral roots, fresh weight of shoot and root were done on randomly selected six seedlings after six months of planting of the stumps. Leaf area was measured on randomly selected five leaves of each two seedlings in a replication. For fresh weight of shoot and root, only newly sprouted shoot and all lateral roots from the stumps were considered for weight measurement leaving original stump. After taking fresh weight, same samples were dried in hot air over at 60 ± 1°C for 12 hours for the record of the dry weight.

Results and discussion

The performance of the teak seedlings in different treatments is presented in **Table 2** and **Table 3**. Treatments varied significantly for the application of fertilizers with respect to all the growth attributes except number of coppices. Application of 1g of N/seedling had significant effect on all growth parameters by producing maximum height (63.50 cm), collar diameter (1.16 cm), number of leaves (9.25/seedling), leaf area (354.80 cm^2), root length (39.60 cm), number of lateral roots (59.50/seedling), fresh weight of shoot (117.70g), dry weight of shoot (55.97g), fresh weight of root (52.03g), dry weight of root (21.67g), total fresh weight (169.73g) and total dry weight of the seedling (77.64g). This was significantly better than remaining treatments except control for number of leaves, leaf area, root length and number of lateral roots. This was followed by control. Very poor performance of all growth parameters were observed in the treatment with 5g of N/seedling. Application of higher dose of nitrogen reduced all growth parameters due its toxic effects. Main reason is the higher nitrogen dose which might have resulted in rapid conversion of carbohydrates into proteins resulting in the formation of thin walled cells. Cereals receiving excess nitrogen have been shown to exhibit lodging as a result of decreased thickness of cellwalls or owing to poor

development of mechanical tissues of stem or both (Kanwar, 1976). These results are similar to those described by other worker such as Van den Driessche (1980) who reviewed both positive and negative effects of nursery fertilizer application. Marshal (1981) concluded that moderate and higher concentration of fertilizers inhibited the height growth of black locust. Pharis and Kramer (1964) in loblolly pine, Schomaker (1969) in white pine, Benzian *et al.,* (1974) in sitca spruce, Kadeba (1978) in *Pinus caribaea*, Deol and Khosla (1983) in Populus species, Kamis Awang and Ismail Katim (1986) in *Gmelina arborea,* Totey *et al.,* (1989) in *Dendrocalamus strictus,* Singh and Banerjee (1999) in *Albizia procera,* and Bhuiyan *et al.* (2000) in *Casuarina equisetifolia* observed that higher doses of nitrogen decreased the growth parameters. In addition, Mohinder Pal *et al.* (1991) did not find significant differences between control treatment and nitrogen treatments in *Dalbergia sissoo* for leaf area.

Fertilizer application at the seedling stage has significant influence on the per cent survival of the seedlings. Optimum dose will help in overcoming adverse effects while over doses resulted in poor survival due to initiation of toxic effects. In the present study, maximum survival (100.00%) was exhibited by control (without fertilizer application) followed by treatment with application of one g of N per seedling. Poor survival of the seedlings (80.00%) was found in treatment containing five g of N per seedling. These results are in agreement with Van den Driessche (1980) who reviewed the individual effects of fertilizer application on seedling survival. Similarly Hortley (1977 in *Eucalyptus tereticornis*) and Kadeba (1978) reported that addition of excess nitrogen on *Pinus caribaea* increased the seedling mortality.

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Table 1 – Details of the treatment

Treatment	N	P (g/bag)	K
T1	1	2	1
T2	2	2	1
T3	3	2	1
T4	4	2	1
T5	5	2	1
T6		Control (No fertilizer)	

Table 2 – Effect of levels of fertilizers on the seedling growth of teak

Treat-ment	N	P	K (g/seedling)	Height (cm)	Collar diameter (cm)	Number of leaves	Leaf area (cm^2)	Survival per cent	Number of coppices	Root length (cm)	Number of lateral roots
1	1	2	1	63.50	1.16	9.25	354.80	97.50 (85.39)	1.72	39.60	59.50
2	2	2	1	49.13	1.01	8.85	316.68	92.50 (78.76)	1.67	35.60	43.50
3	3	2	1	43.13	0.92	8.25	300.10	87.50 (72.49)	1.71	35.40	38.75
4	4	2	1	41.00	0.87	7.71	295.13	82.50 (68.41)	1.66	31.20	29.00
5	5	2	1	39.00	0.80	6.75	288.98	80.00 (63.81)	1.67	29.20	21.25
6	Control			56.00	1.03	9.11	341.00	100.00 (90.00)	1.73	38.40	52.50
S.Em ±				2.27	0.02	0.51	12.00	5.58	0.04	1.54	2.89
C. D. at 5%				6.84	0.07	1.53	36.17	17.10	NS	4.63	8.71
C. D. at 1%				9.46	0.07	2.11	50.01	NS	NS	6.40	12.04

NS indicates non-significant. Figures in parenthesis are arc-sine transformed values.

Table 3 – Effect of levels of fertilizers on the seedling biomass of teak

Treat-ment	N	P	K (g/seedling)	Fresh weight of shoot (g)	Fresh weight of root (g)	Total fresh weight (g)	Dry weight of shoot (g)	Dry weight of root (g)	Dry weight of seedling (g)
1	1	2	1	117.70	52.03	169.73	55.97	21.67	77.64
2	2	2	1	72.23	42.66	114.89	31.57	16.39	47.96
3	3	2	1	65.04	32.41	97.45	27.43	10.52	37.95
4	4	2	1	62.07	29.41	91.48	24.88	9.43	34.31
5	5	2	1	59.24	24.89	84.13	24.50	8.49	32.99
6	Control			92.55	46.58	139.13	40.15	18.38	58.53
S.Em ±				2.57	1.57	2.63	1.66	0.91	1.50
C. D. at 5%				7.75	4.73	7.93	5.02	2.73	4.53
C. D. at 1%				10.72	6.53	10.95	6.93	3.76	6.25

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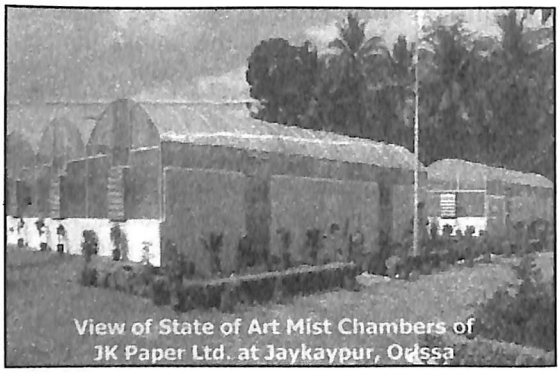

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PROVENANCE VARIATION IN TREE AND SEED MORPHOLOGICAL CHARACTERS OF *PROSOPIS CINERARIA* (L.) DRUCE

RAVINDER KUMAR[1], O. P. TOKY[2] and D. CHOPRA[3]

ABSTRACT

30 provenances of *Prosopis cineraria* were observed for various tree and seed characters. The Kadmadi village provenance had maximum tree height as well as dbh i.e. 15.15m and 340cm, respectively. The trees grown in sandy and loamy soils showed better growth characteristics. The Mukam village (I) provenance was found as best provenance on the basis of seed weight as it had maximum seed weight of 72.0 mg/ seed. Whereas, maximum seed breadth was found in Rewari city provenance i.e. 4.89mm. By using heavy and bold seeds of superior provenances better quality plants of *Prosopis cineraria* can be attained and afforestation can be done successfully in arid and semi arid regions.

Introduction

In hot deserts of India *Prosopis cineraria*, locally called "Jandi" or "Khejri" is a boon to the people due to its myriad virtues. It is distributed discontinuously in dry and semi-dry regions of north and western parts of India. It not only provides fodder, fuelwood and timber but also has nitrogen fixing ability with micro-symbiotic affinity. Its unripe pods are also being used for the preparation of curries and pickles (Khasgiwal *et al.*, 1969).

Provenance tests in *Prosopis cineraria* is desirable to screen the naturally available genetic variation to utilize the best material for maximum productivity and for future breeding work. The bigger seed size imparts seedling vigour and uniform germination (Shivkumar and Banerjee, 1986). If germination of big sized seeds produces better seedling vigour, then assessment for variation and subsequent selection for bigger seed size may be useful. Therefore, information is necessary on the provenance variations in *Prosopis cineraria* seed parameters before taking up any type of tree improvement.

Materials and method

To study the tree and seed morphological characters of *Prosopis cineraria*-30 plus trees situated at different-provenances (locations) of Rajasthan and Haryana were selected. The criteria of selection of plus trees was phenotypic characteristics of the tree such as straight bole, better growing, insect pest free and low branch angle. Total height, diameter at breast height (dbh) and clear bole height of the trees of which seeds were collected were also measured. To study the seed characters fifteen pods from each tree

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were taken randomly and from each pod ten seeds were taken for measuring their seed weight, length and breadth, and their mean value was calculated for each character.

Result and discussion

The trees of *Prosopis cineraria* provenances showed wide variations in their total height, clear bole and diameter at breast height **(Table1).** The total height of Kadmadi village provenance was maximum i.e. 15.15m followed by Nagour village provenance (13.63m), whereas it was minimum in Jodhpur city (I) provenance i.e. 3.64m followed by Jodhpur city (II) (3.66m). The maximum clear bole was found in Mukam village-VIII provenance, i.e. 6.16m, while it was minimum in Jodhpur city (I) provenance i.e. 1.81m. The dbh of Kadmadi village provenance was highest (340cm) followed by Jaipur city (III) provenance i.e. 155mm. It was found that trees of *Prosopis cineraria* grown in Kankrily soil had poor height, clear bole and dbh as compared to trees grown in sandy and loamy soils. Kackar *et al.,* (1986a) also found variation in morphological characters of *Prosopis cineraria* in natural stands from various sites and rainfall zones of the western Rajasthan. Sharma (1966) and Satchell (1978) reported that in the sand-hill areas of Rajasthan and the United Arab Emirates, *Prosopis* species grows relatively well in the hollows between dunes and to a lesser extent on the intervening plains and it is favoured by coarse, sandy and alkaline soils.

Significant variation existed in seed weight, length and breadth **(Table 2).** The average seed weight varied from 39.6 mg/seed in Mukam village (V) provenance to 72.0 mg/seed Mukam village (I) provenance with a general mean of 52.2 mg/seed. The provenances Mukam village (I), Jodhpur city (III), Rewari city and Mukam village (VIII) had significantly ($P<0.05$) higher seed weights than the general mean. The mean seed length of Mukam village (I), Nandri village (III), Rewari city, Nagour village, Kadmadi village, Mukam village (VI), Jaipur city (III) and Mukam village (VIII) provenances were significantly ($P<0.05$) higher than the general mean. It varied from 5.39 mm in Jodhpur city (I) to 7.42mm in Nandri village (III) with a general mean of 6.25mm. The mean breadth of seed was minimum (3.82mm) in Mukam village (V) and maximum (4.89mm) in Rewari city provenance with a general mean of 4.28mm. The coefficient of variation was the greatest for seed weight (11.72%) and the least for seed breadth (6.54%). The variation in seed characters of *Prosopis cineraria* have been attributed to mother tree differences and these are as a result of large variation in climatic conditions in areas of its natural distribution. The variations are expected since it is cross pollinated species. Variation in seed characters of different provenances of *Prosopis cineraria* were also reported by Kackar *et al.,* (1986b), Arya *et al.,* (1992) and Bahadur and Hooda (1995). By selecting heavy and bold seeds other important parameters can be improved as, Chopra and Hooda (2001) reported positive correlation between 100-seed weight and various seed viability and vigour parameters in *Prosopis juliflora.* Therefore, by using heavy seeds vigorous seedlings may be obtained and the best material can be used for afforestation of arid and semi arid zones.

Table 1: Tree morphological characteristics of *Prosopis cineraria* provenances

Provenance	Height (m)	Clear bole (m)	dbh (cm)	Soil type
Jodhpur city (I)	3.64	1.81	70	Kankrily
Nandri village (I)	12.12	3.03	105	Sandy
Jodhpur city(II)	11.51	3.93	85	Sandy
Nandri village (II)	10.60	6.06	110	Sandy
Jaipur city (I)	10.90	2.72	72.5	Loam
Mukam village (I)	11.81	3.63	74.5	Kankrily
Jodhpur city (III)	5.45	1.84	55	Kankrily
Mukam village (II)	9.69	6.08	85	Sandy
Jodhpur city (IV)	3.66	1.86	75	Kankrily
Mukam village (III)	8.78	6.04	70	Sandy
Nandri village (III)	9.69	3.33	55	Loam
Ratnagarh city	8.68	4.51	95	Sandy
Jodhpur city (V)	9.09	4.54	45	Kankrily
Mukam village (IV)	9.39	4.24	60	Sandy
Jodhpur city (VI)	9.14	2.42	90	Kankrily
Cazri, Jodhpur	9.79	2.72	82.5	Kankrily
Mukam village (V)	9.58	6.12	102.5	Sandy
Jaipur city (II)	4.54	3.03	85	Loam
Sandwa village	10.98	4.24	105	Sandy
Rewari city	9.39	3.03	90	Loam
Nagour village	13.63	4.54	130	Loam
Kadmadi village	15.15	3.63	340	Sandy
Ajmer city (I)	6.96	2.12	40	Kankrily
Ajmer city (II)	10.04	4.14	127.5	Kankrily
Mukam village (VI)	8.76	4.64	112.5	Sandy
Chediya village	11.21	5.45	135	Loam
Sahbajpur village	7.87	3.33	122.5	Loam
Mukam village (VII)	9.48	6.06	88	Sandy
Jaipur city (III)	7.57	3.03	155	Loam
Mukam village (VIII)	9.36	6.16	92.5	Sandy
Range	3.64-15.15	1.81-6.16	40-340	

Table 2: Seed characters of Prosopis cineraria provenances

Provenance	Seed weight (mg / seed)	Seed length (mm)	Seed breadth (mm)
Jodhpur city (I)	40.2	6.27	3.91
Nandri village (I)	54.8	6.27	4.73
Jodhpur city (II)	58.0	6.06	4.43
Nandri village (II)	52.8	5.86	4.27
Jaipur city (1)	56.4	5.89	4.37
Mukam village (I)	72.0	7.19	4.58
Jodhpur city (III)	55.6	5.39	4.32
Mukam village (II)	47.2	5.41	4.63
Jodhpur city (IV)	48.0	5.88	4.31
Mukam village (III)	54.4	6.16	4.01
Nandri village (III)	59.2	7.42	4.05
Ratnagarh city	48.0	5.71	4.18
Jodhpur city (V)	41.2	6.39	4.07
Mukam village (IV)	46.8	5.70	4.26
Jodhpur city (VI)	47.2	5.93	4.13
Cazri, Jodhpur	48.4	5.85	3.90
Mukam village (V)	39.6	5.88	3.82
Jaipur city (II)	55.2	5.67	4.54
Sandwa village	62.8	6.65	4.23
Rewari city	61.2	7.40	4.89
Nagour village	57.2	6.82	4.41
Kadmadi village	50.8	6.87	4.01
Ajmer city (1)	43.2	6.44	4.11
Ajmer city(II)	50.4	5.74	4.31
Mukam village (VI)	48.0	6.82	4.34
Chediya village	48.4	5.60	4.28
Sahbajpur village	46.0	5.93	4.28
Mukam village (VII)	55.2	6.49	4.36
Jaipur city (111)	52.4	7.07	4.25
Mukam village (VIII)	66.0	6.83	4.36
Mean	52.2	6.25	4.28
C.D. at 5%	7.66	0.43	0.20
C.V. (%)	11.72	10.72	6.54

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FERTILIZER USE EFFICIENCY AND ECONOMICS FOR PRODUCING HEALTHY SEEDLINGS OF ALBIZIA LEBBECK (L.) BENTH.

JAI KUMAR AND M.H. SIDDIQUI[1]

ABSTRACT

The fertilizer use efficiency and economics was calculated for seven-month-old *Albizia lebbeck* (L.) Benth. Seedlings in nursery. Nitrogenous fertilizers were found to be more effective than potassium and phosphate fertilizers. Maximum fertilizer use efficiency was shown by N_{50} (39.60), followed by K_{75} (34.00), while minimum fertilizer use efficiency was shown by N_{150} (5.90). Per seedling production cost was found as Rs. 2.02 and Rs. 2.01 for fertilized and unfertilized plants, respectively. By application of fertilizer nursing period could be reduced by 3 months for producing plantable size of seedlings by incurring less than a paisa on fertilizer purchase for one seedling.

Key words : Fertilizer Use Efficiency, *Albizia lebbeck*, Seedling, Economic analysis

Introduction

Fertilizers are being used on an increasing scale in forestry allover the world to rectify nutritional deficiencies of soil for increased growth and biomass production. A basic knowledge of the nutritional requirements of the important plantation species at different stages of their growth is essential before fertilizer application. Therefore, a systematic research is needed to determine the type and quantity of fertilizer showing maximum response. Production of high quality seedlings in nursery is pre-requisite for the success of any plantation. Nitrogen fixing species assume considerable importance in this context for a their soil ameliorating characteristic, because they produces large amount of biomass, which can release nutrients to increase soil fertility, reduce fertilizer needs and increase crop yield (Tirra and Asghar, 1990).

Albizia lebbeck (L.) Benth. is a nitrogen fixing leguminous tree belonging to family Leguminaceae and it is commonly called as "Kala Siris" or "Siris", while for trade purpose it is called as "Kokko". Siris is a moderate to large deciduous tree usually with a straight bole and broad crown. At maturity, it attains a height of 18m with approximately 6 -9 m clear bole and a girth of 1.5-1.8 m (Anon., 1983). Siris is a suitable species for sandy plains, shallow soil, sand stone and rocky sites. Besides timber, it also provides fuel wood and fodder. Most livestock readily eat leaves and young twigs.

Material and method

Three types of fertilizers *viz.* urea, single superphosphate (SSP) and muriate of potash (MOP) were used in mg weight per poly tube

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either singly or in combination. The 15 treatments including control (untreated) were $N_0P_0K_0$, N_{50}, N_{100}, N_{150}, P_{50}, P_{100}, P_{150},K_{25}, K_{50}, K_{75}, $N_{50}P_{50}$, $P_{50}K_{50}$, $N_{50}K_{50}$, $N_{50}P_{50}K_{50}$ and $N_{100}P_{100}K_{50}$ and they were replicated thrice. The treatments were arranged in completely Randomized Design. All treatments of single superphosphate and muriate of potash were applied as basal dose, i.e. at the time of tube filling and simultaneous seed sowing, however urea was applied as one basal dose and two equal split doses at 15 days interval.

Fertilizer use efficiency- The total dry weight of seedlings of a treatment was measured at 7 months age by drying the seedlings in an electric oven at 50°C. The dry weight of seventh month old seedlings was utilized for calculation of Fertilizer U se Efficiency and Economics of producing a healthy seedling. The fertilizer use efficiency which measures effectiveness of a plant for producing maximum biomass by consuming unit dose of fertilizer was calculated to determine mg dry biomass production per mg fertilizer used for all the treatment in comparison to the untreated seedlings. The Fertilizer Use Efficiency was calculated by adopting the formula of Prasad and Rawat (1991) as given below -

$$\text{Fertilizer Use Efficiency} = \frac{E_F - E_O}{F}$$

Where E_F - Dry biomass of fertilized plants (mg)

E_O - Dry biomass of unfertilized plants (mg)

F - Quantity (mg) of fertilizer (Urea, SSP or MOP) applied

Economic Analysis- Economic analysis for producing seedlings of plantable height was done to know the cost of production after seven-months age under nursery conditions. The various costs involved in the seedling production up to seven months age such as cost of seed, cost of polythene tubes, cost of fertilizer, cost of filling and transporting the soil, cost of filling polythene tubes (1350 in number), cost of watering and weeding the seedlings up to seventh month and miscellaneous cost which included protection etc. were added together for calculation. The total cost for producing an individual seedling was calculated by dividing the grand total cost with the total number of seedling of seven-month age was expressed in rupees. Production cost of an untreated seedling was also calculated.

Results and discussion

Fertilizer use efficiency- The Fertilizer Use Efficiency of *Albizia lebbeck* seedlings grown in polypots for seven month is given in **Table 1.** In case of different doses of Urea, maximum fertilizer use efficiency was shown by N_{50} (39.60), which was found decreased from 29.70 to 5.90 with increasing the levels of nitrogen from N_{100} to N_{150}. In case of different doses of SSP, nearly same fertilizer use efficiency was obtained as compared to higher level. In case of different doses of MOP, maximum fertilizer use efficiency was shown by the treatment K75 (34.00), while minimum fertilizer use efficiency was shown by N_{150} (5.90), which indicated that lower doses of nitrogenous fertilizer and higher doses of potassic fertilizer are the main nutrients for producing more dry biomass of *Albizia lebbeck* seedlings in nursery.

It is clearly visible that different types of fertilizers behaved differently **Fig-1.** Nitrogenous fertilizer was found more effective than potassic and phosphatic fertilizer. Similar to present findings, Singh *et. al.* (1991) mentioned that nitrogen use efficiency was higher at lower dose of nitrogen applied in case of *Leucaena leucocephala* seedlings. Similarly, Prasad and Rawat (1991) in case of *Acacia nilotica* seedlings found maximum (72.6 mg/mg N) fertilizer use efficiency at 50 ppm N -treatment, while decreasing trend was noticed with increasing the dose of nitrogenous fertilizer.

Economic Analysis- Economic calculation for *Albizia lebbeck* seedlings up to seven-month age with or without fertilizers is given in **Table 2.** The numbers of seedlings raised in all the treatments were 1350 and to calculate the cost of one seedling, various types of expenditure were added up to seven-month age. Rate of manpower per day was Rs. 52.00 based on Birsa Agricultural University casual labour rate. The total cost calculated for 1350 seedlings grown over 28 weeks with fertilizer and without fertilizer was Rs. 2729.25 and Rs. 2723.25, respectively. In this way per seedling production cost was found as Rs. 2.02 and Rs. 2.01 for fertilizer grown and without fertilizer grown respectively. In this research, at the seventh month the seedling height in treatments N100 and $N_{100}P_{100}K_{50}$ was 20.40 cm and 19.70 cm respectively, while in control the seedling height was 12.50 cm.

Generally, 20 cm height is considered as optimum height for planting, which can be obtained by the use of fertilizers like 100 mg Urea and combination of NPK as 100 mg Urea, 100 m& SSP and 50 mg MOP. But to produce seedlings of this height without the application of fertilizers, about 10-11 months time would be needed, because in seventh month, the height was only 12.50 cm. Thus, by the application of fertilizer in less time required height could achieved, i.e. a nursery period of about 3 months can be reduced to have plantable sized of seedlings by incurring less than a paisa on fertilizer purchase for one seedling.

Again, the production cost for over 10 month seedlings is higher, because of more cost incurred in watering, weeding and protection. In watering the seedlings total cost calculated up to 10 months would be 1040.00, while cost of weeding will be Rs. 260.00 along with Rs. 1500.00 as miscellaneous cost. Therefore, production cost of 1350 seedlings, if fertilizer is not applied will be Rs. 3563.25, thereby raising production cost per seedling to Rs. 2.63. Chinnathurai *et. al.* (1997) mentioned that due to combined application of NPK fertilizer on multipurpose tree such as *Albizia lebbeck, Acacia nilotica, Acacia planiformis,* nursery period is reduced considerably resulting in reduced maintenance cost.

Acknowledgements

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Table 1: Fertilizer Use Efficiency of *Albizia lebbeck* (L.) Benth. Seedlings grown in polypots in nursery for productlon of unit dry blomass.

Fertilizer Treatments (mg)	E_F-E_O (gm)	E_F-E_O (mg)	F.U.E. = $\frac{E_F-E_O}{F}$
N_{50}	3.680-1.7=1.980	1980	39.60
N_{100}	4.670-1.7=2.970	2970	29.70
N_{150}	2.586-1.7=0.886	886	5.90
P_{50}	2.573-1.7=0.873	873	17.46
P_{100}	3.523-1.7=1.823	1823	18.23
P_{150}	4.426-1.7=2.726	2726	18.17
K_{25}	2.116-1.7=0.416	416	16.64
K_{50}	2.046-1.7=0.346	346	6.92
K_{75}	4.250-1.7=2.550	2550	34.00
N_{50} P_{50}	2.676-1.7=0.976	976	9.76
$N_{50}K_{50}$	3.817-1.7=2.117	2117	21.17
$P_{50}K_{50}$	3.043-1.7=1.343	1343	13.43
N_{50} P_{50} K_{50}	4.776-1.7=3.076	3076	20.50
$N_{100}P_{100}K_{50}$	5.566-1.7=3.866	3866	15.46

E_F = Dry biomass grown with fertilizers plants
E_O = Dry biomass of grown without fertilizeres plants (1.700 gill)
F = Urea, SSP or MOP fertilizer applied in mg.

Table 2: Economic Analysis for preparing seven-month-old *Albizia lebbeck* (L.) Benth. seedling in nursery in polypots.

Sl. No.	Particulars				Cost (Rs.)
1.	Cost of seed Total quantity of seed used = 750 gm or 0.75 kg Rate of seed/kg = Rs.75.00 Total cost of seed = 0.75 x 75.00 = Rs.56.25				56.25
2.	Cost of polythene tubes Total number of polythene tubes used = 1350 Rate of polythene tubes/thousand = Rs.1 00.00 or Rs.0.1 per tube Total cost of 1350 polythene tubes = 1350 x 0.1 = Rs.135.00				135.00
3.	Cost of fertilizer				
	Fertilizer	Quantity used	Rate (Rs/kg)	Cost incurred (Rs.)	
	Urea	500 gm	4.50	2.25	
	SSP	500 gm	3.50	1.75	
	MOP	500 gm	5.00	2.50	
	Total cost			6.50	6.50

Sl. No.	Particulars	Cost (Rs.)
4.	Cost of digging & transporting the soil Total weight of soil required in single polypots= 0.5 kg Total quantity of soil required to fill 1350 polypots= 675 kg Total manpower required (men per days) = 6 Manpower rate (Rs/day) = 52.00 Total cost incurred = 52.00 x 6 = Rs.312.00	312.00
5.	Cost of filling 1350 polythene tubes Number ofpolythene tubes filled by one person = 270 polypots per day Total manpower required (men per day) = 5 Manpower rate (Rs/day) = Rs.52.00 Total cost incurred 52.00 x 5 = Rs.260.00	260.00
6.	Cost of watering the seedlings Watering schedule = Twice in a week Total time incurred = 28 weeks Manpower required in a week = y. man per day Cost of one manpower/day = Rs.52.00 Per week expenditure = 52 x y. = Rs.26.00 Total cost for irrigation = 26x28 = Rs.728.00	728.00
7.	Cost of weeding Weeding schedule = Twice in a month Total time incurred = 7 month Manpower required in a month = y. man per day Cost of one manpower per day = Rs.52.00 Total cost per month = Y2 x 52 = Rs.26.00 Total cost = 26x7 = Rs.182.00	182.00
8.	Miscellaneous cost (protection etc.) Total amount needed for a month = Rs.150.00 Total time = Seven month Total cost = 150.00 x 7 = Rs.l 050.00	1050.00
	Total cost Rs.	2729.75

Grand Total Cost (Rs) : 2729.25
Total Number of Seedling Raised : 1350
Per Seedling Production Cost (Rs.) : 2729.75 + 1350 = Rs. 2.02
Grand Total Cost with Fertilizer (Rs.) : 2723.25
Per Seedling Production Cost without fertilizer (Rs.) : 2723.25 + 1350 = Rs.2.01

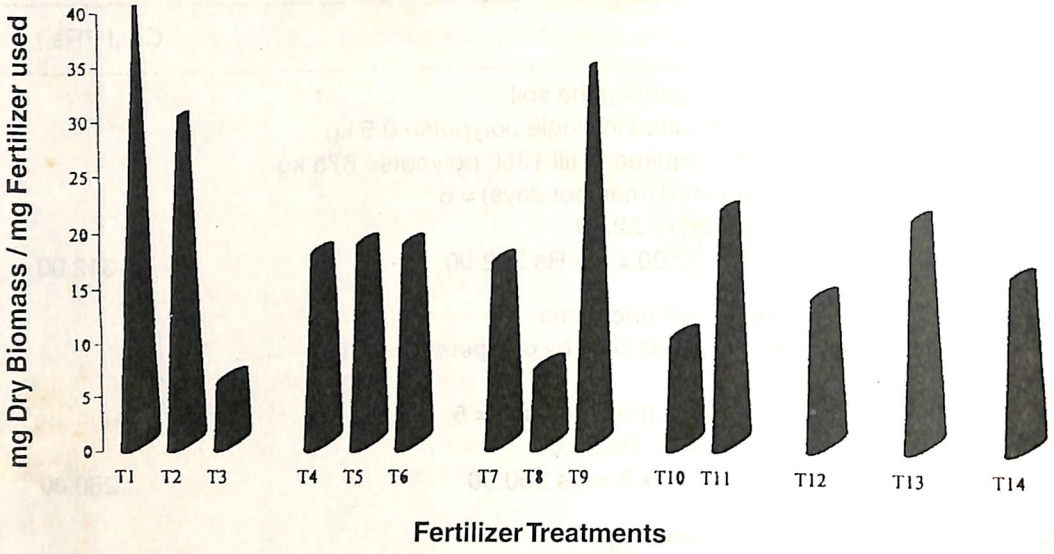

Figure 1 – Fertilizer Use Efficiency of *Albizia lebbeck (L.) Benth.* Seedlings in nursery for producing unit dry matter yield.

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ARBUSCULAR MYCORRHIZAL ASSOCIATION IN THE FOREST TREES OF NORTHEASTERN REGION OF INDIA

D. Dutta, D. P. Bora and R. K. Kalita*

Introduction

The symbiotic association of Arbuscular Mycorrhizal (AM) fungi in plant roots is a natural phenomenon that co-existed throughout the evolution of plants on the earth. This association is characterized by the presence of mycelia, vesicles and arbuscules in the cortical region of roots and helps both the partners in terms nutrition, growth and development and other aspects like drought, salt stress, toxicity of soil environment and pathogenic attacks (Harley and Smith, 1983). AM fungi are known to have a worldwide distribution with little specificity in selection of their host plant (Mosse *et al.*, 1981; Danial-Hetrick, 1984). About 90 percent of the plants surviving throughout the world form arbuscular mycorrhiza and a wide range of plants responds to this symbiotic association (Plenchette *et al.*, 1983). It has been reported that arid and semi-arid regions of the world, where soil organic matters is low, AM fungi are most common (Allen *et al.*, 1995). The majority of the temperate, sub-tropical and tropical plant communities are infected by AM fungi (Trappe, 1987). Population of AM fungi in a particular environment depends mainly on the different factors of environment such as changes in the plant community, edaphic and climatic factors (Read *et al.*, 1976; St. John and Coleman, 1983; Miller, 1987; Allen, 1996). Many workers also reported that arbuscular mycorrhizal fungi play an important role in the establishment of plant community in disturbed sites (Reeves *et al.*, 1979; Allen and Allen, 1980). Inoculation of arbuscular mycorrhizal fungi increase plant productivity for which research has been carried out for the use of AM fungi as biofertilizer in agricultural, horticultural and forestry crops.

Northeastern region of India is an extension of lesser Himalayas comprising of as many as 51 types of forests characterized by highly humid climate with rich diversity of flora (Champion and Seth, 1964). This part of India has a richer stock flora and fauna both in number and type. The different soils of the region harbor a vast number of microbial population that help above ground flora directly or indirectly through their activities in soil. This paper reviews the work done on AM fungi in different forest trees of Northeastern region India.

Organizations volved In research On amfungi in northeastern region of India

The research on AM fungi in northeastern region was initiated by North

Rain Forest Research Institute, Jorhat Assam.
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Eastern Hills University, Shillong, in the seventies of last century in the different forests of Meghalaya. These studies aimed to understand the ecology of AM fungi in the secondary successional plants of the disturbed sites, agro-ecosystems and interaction of AM fungi with other beneficial microbes (*Frankia*). Since then, research on AM fungi in this region is being carried out by various institutions such as Regional Research Laboratory, Jorhat; Assam Agricultural University, Jorhat; Tocklai Experimental Station, Jorhat; Rain Forest Research Institute, Jorhat; Guwahati University, Guwahati; SFS College, Burnihat with good number of survey in different fields and areas of the region. All these institutions involved with the research on AM fungi with respect to their occurrence at different areas like forestry, fallow lands, agriculture, horticulture and tea plantation.

Distribution of am fungi in northeastearn region

Bakshi (1974) collected spores of *Glomus macrocarpus* from the forest of Amsoi in middle Assam. This is the first report of occurrence of AM fungi in the region. Venkataraman *et al.,* (1985) from a survey of seven localities of Jorhat, Assam isolated *Gigaspora nigra, Glomus mosseae, Glomus fasciculatum* and *Sclerocystis rubiformis* of which *Gigaspora nigra* was found most common. Extensive survey carried out in the eighties by Assam Agricultural University revealed the existence of pee. *Acaulospora, Enthropospora, Gigaspora, Glomus, Sclerocystis* and *Scutellospora* in different locations of Assam (Borthakur, 2001; Talukdar *et al.*, 2001).

Quantitative studies on AM fungi were also done by different workers in the different localities of northeastern region. Joshi *et al.* (1991) studied the diversity of AM fungi in four different communities: an undisturbed forest, undisturbed grassland, disturbed grassland and a highly disturbed plant communities in Jowai, Meghalaya and found that *Acaulospora* was present in undisturbed forest whereas *Glomus* and *Gigaspora* were common in other localities. Changes in the population of AM fungi in the degraded hill areas of shifting cultivation were studied in different localities of the region (Verma, 1990; Verma and Kapoor, 1994; Dutta *et al.*, 1996). Chakrabarty and Talukadar (1997) studied the population of AM fungi under different land use pattern in a farmland in Assam Agricultural University, Jorhat Assam, and found high spore number in agricultural field. Dutta *et al.*, (1996) isolated spores of the species of *Glomus, Gigaspora, Acaulospora* from fallow areas of *jhum* fields of Karbi Anglong, Assam and found high spore number in short cycled *jhum* fallow. From a study of AM fungi population in disturbed sites due to coalmining at Margherita coal belt of Assam, it was reported that spore number in coalmine overburden spoils increase up to 10 years after which it declines (Hazarika *et al.*, 1996). This study also reported the occurrence of *Glomus, Gigaspora, Acaulospora* and *Enthropospora* from the coalmine areas of upper Assam. Kalita *et al.* (2002) studied few native plants for their association with AM fungi and found that *Argyreia* sp. showed the highest (45%) root infection and *Borreria hispida* showed lowest (17%). On the other hand *B. hispida* harbored the highest number of spores in its

rhizosphere (294 per 50g of soil). *Glomus* was the most abundant AM fungi associated with the plants studied.

Am fungal association in plants of norhearsteren region

Kharbuli and Mishra (1982) made a general screening of mycorrhizal infection in the roots of 18 tree species of 6 different localities of Meghalaya and reported the presence of AM fungi infection in all the species except 3 plants belonging to the family Fagaceae, Dipterocarpaceae and Betulaceae. They however, reported ectomycorrhizal association in the roots of *Shorea robusta* (Dipterocarpaceae). Sharma *et al.* (1986) from a study of the mycorrhizal status in 25 tree species in sub-tropical forest ecosystem in Meghalaya and found that vesicular arbuscular infection was dominant (18 species) followed by ectomycorrhizal (5 species), ericoid (2 species) and ectendo-mycorrhizal infection. Borthakur *et al.* (1987) reported the occurrence of AM fungi association in tea (*Camellia sinensis*) from northeastern India. They isolated spores of *Acaulospora, Glomus, Gigaspora and Sclerocsystis* from the rhizosphere soils of the tea gardens of Assam. In the year 1991 a preliminary investigation on the mycorrhizal status of tree and shrubs at field and nursery was carried out in Rain Forest Research Institute, Jorhat, Assam and since then this Institute has been involved in research of AM fungi in northeastern region (Dutta *et al.*, 1995, Hazarika *et al.*1995; Dhungana *et al.*, 1996; Abha Rani *et al.*, 1996: Bora *et al*, 1999; Kalita *et al.*, 2002). A study was carried out on the status of AM fungi in seedlings of economically important tree species grown in different forest nurseries of Jorhat district, Assam, all the species showed AM fungi infection at different level. This study however did not find any relationship between spore number and percent colonization in root in polypots seedlings (Dhungana *et al.*, 1996). Dutta *et al.*, (1996) reported the occurrence of AM fungi in the roots 20 plants species collected from degraded forest of Nagaland and Assam. Hazarika *et al.* (1995), studied three species of bamboo *Bambusa tulda*, *B. balcooa* and *B. nutans* from five different localities in Jorhat district, Assam and found that AM fungal colonization in roots vary with sites as well as species. They also reported more diverse spore types in the root region soil of *B. nutans*. Abha Rani (1995) worked out the status of AM fungi in three important timber yielding species, *Tectona grandis, Gmelina arborea* and *Michelia champaca* in forest nurseries of Nagaon, Assam. All these tree species showed AM fungal structures in their roots. Borah *et al.* (1999) studied the AM fungal status of different rattan (cane) growing areas of Assam and Mizoram and observed low percent infection in the root irrespective of species and the locations. They observed five different spore types of *Glomus* sp. with spore number ranging from 127 to 2420/50 g soils.

Effect of inoculation of am fungi onD9fferent plants

Unlike substantial works done on agricultural and horticultural crops, the works on the effect of AM fungi on growth and development of forest tree species from Northeast are very less. Growth responses

of different agricultural crops like chilli (Hazarika and Phookan, 1995), tomato and green gram (Das *et al.* 1995) were reported in the region. Rahman and Talukdar (1996) inoculated spores of locally isolated *Glomus* sp to micro propagated Khasi mandarin (*Citrus reticulata* Blanco) and found that inoculated plants showed better growth and P absorption comparing to that of the uninoculated plants. Inoculation of AM fungi in Assam lemon (*Citrus limon* L.) enhanced P uptake with the increase of acid phosphatase activities in roots of inoculated plants (Chaudhury *et al.*, 1999). Effect of dual inoculation of species *Glomus* and *Frankia* was studied on *Alnus nepalensis*, a forest plant grown in shifting cultivation areas of the region and positive response was observed in growth and nitrogen fixation (Jha *et al.*, 1993). Dual inoculation of *Glomus mosseae* and *Frankia* reported to improve growth, biomass, nitrogenase activity and mycorrhizal infection level in *A. nepalensis* (Tiwari, 1995). Improved growth by the inoculation of AM fungi was observed in *Mimosa pudica* and *Crotalaria striata* in soil collected from overburden dumps of Tikak Colliary, Margherita in Upper Assam (Hazarika *et al.*, 1996). Talukdar and Thakuria (2000) inoculated AM fungi in two economically important timber yielding plant *Tectona grandis* and *Gmelina arborea* using degraded soils and found that AM fungi inoculation with organic amendments gave better yield in terms of shoot and root biomass.

FUTURE PROSPECT OF AM FUNGAL RESEARCH IN NORTHEASTERN REGION

Northeastern region of India is bestowed with abundant natural resources and climatic variations but many of them have not been studied in details. The research on AM fungal association with forest trees is relatively a new in this region. There is a tremendous scope to work on various aspects of AM fungi of this region. Comprehensive and systematic study of these fungi, their use as biofertilizer for improvement of forest stock, their role in mineral cycling, energy flow and plant succession in disturbed and undisturbed ecosystem, their role in plant disease management etc. are some of the broad areas which need to be addressed.

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GOVERNMENT OF KARNATAKA

No DPAR 99 SFP 2002

Karnataka Government
Secretariat
Vidhana Soudha, Bangalore

Dated 5th April, 2003

NOTIFICATION

Dr. Shobhanath Rai, IFS (KN 68), Principal Chief Conservator of Forests (Evaluation, Working Plan, Research & Training) Bangalore, is transferred with immediate effect and posted until further orders as Principal Chief Conservator of Forests, Bangalore, vice Shri. Ram Mohan Ray, IFS, transferred.

The orders issued in Government Notification No. DPAR 99 SFP 2002, dated 5-3-2003, placing the services of Dr. Shobhanath Rai, IFS, at the disposal of Agriculture and Horticulture Department for posting him as Executive Directore, Karnataka Watershed Development Society, Bangalore, stand cancelled.

BY ORDER AND IN THE NAME OF THE
GOVERNOR OF KARNATAKA

(N. Srinivas Murthy)
Under Secretary to Government, I/c
D.P. & A.R. (Services-I)

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EFFECT OF SEED COLOUR AND SEED SIZE ON SEEDLING QUALITY IN *BASSIA LONGIFOLIA,* LINN

K. K. SURESH, I. SEKAR and A. VIJAYARAGHAVAN

ABSTRACT

Bassia longifolia seeds collected on ground exhibit different colour and size. An experiment was conducted to study the effect of seed colour (light brown, brown and dark brown) and seed size (big, medium and small) on seed and seedling quality in *Bassia longifolia*. The results revealed that dark brown seeds had the best seed characters (seed length, breadth, Kernel weight, Kernel / seed coat ratio, and 100 seed weight) and the highest germination percentage. All these characters enhanced the seedling quality under this seed colour. With regard to seed size, bigger seeds recorded significantly superior seed characters and in turn produced high quality seedlings.

Key words: *Bassia longifolia*, seed colour, seed size, seedling quality

Introduction

Bassia longifolia, Linn, is a large evergreen tree confined to dry tropical and sub tropical climate. This tree is grown for its nutritious flowers, which are consumed in rural areas and for their seed, which yields 20-50% fatty oil, which is used in soap manufacturing. Refined oil is used in cooking, confectionary, chocolate making, candle making, producing alcohols and stearic acid. The tree flowers during March-April and seeds are shed from fruits during July-August. Quality seeds will play a vital role in producing quality seedlings for out planting. Mostly seeds collected on ground seeds are used for sowing which show wide variations in seed colour and seed size. This is also reflected in germination percentage and quality of seedlings obtained from such seeds in this species. Baker, (1972) reported that large seeds produced vigorous seedlings, which could penetrate its root to deeper layer and withstand drought. According to Cavers & Steel (1984) seed weight and size are influenced by the age of the parent plant. A close relationship between seed size / weight and seed quality has been documented for many tropical hardwoods (Gupta *et at.,* 1983, Ponnammal *et at.,* 1993,Suresh, 1994). Several scientists have also reported on the importance of fruit colour on seed and seedling quality (Bonner 1974, Rietveld1978, Ponnuswamy *et at.,* 1993). However, the effect of seed colour on seed and seedling quality is lacking. Hence this study was taken up to find out the effect of seed colour and seed

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size on the seed and seedling quality in this species.

Materials and method

Experiment: I. Seeds were collected from 30 year old trees of *Bassia longifolia* at Sugarcane Research Station, Cuddalore, Tamilnadu, India. Seeds collected during August 2000 were classified into three colours *viz.,* (i) Light brown (ii) Brown and (iii) Dark brown. Seed characters like seed length, seed breadth, were recorded using dial caliper.100 seed weight. Kernel weight. shell weight. Kernel / Seed coat ratio were recorded from 100 fresh seeds in each colour for each replication and there were seven replication. Germination percentage was recorded on 21st day after sowing (ISTA-1985).

From the freshly collected seeds for each replication 100 good seeds was selected from each colour and were sown into polybags (20cm x 15 cm filled with soil. sand and FYM in the ratio of 3:1:1) at the rate of one seed/bag. Likewise there were seven replication. The seedling characters *viz.,* shoot length. root length. shoot weight/plant. root weight/plant and shoot/root ratio were recorded on 45th and 90th day after sowing.

Experiment: 2. The results from first Experiment revealed that the Dark brown seeds gave high germination and quality seedlings. These color seeds were then used to study the effect of seed size on seedling quality in this species.

The ground collected fresh seed from the dark brown seeds were graded into 3 sizes as big seeds (>3.0 cm). Medium size seeds (2.0- 3 cm) and small seeds (<2.0cm). In these grades. 100 seeds were taken for each grade for each replication and seed characters as studied under the seed color were evaluated. Then 100 seeds for each grade were sown in polybags. (20 x 15cm filled with soil. sand and FYM in the ratio of 3:1:1) at the rate of one seed /bag and the seedling characters were studied as under seed color on 45th and 90th day after sowing. The treatments were replicated seven times.

The above two experiments were conducted under Randomised Block Design and the data collected was analysed as per Frank Freese (1967).

Results and discussion

Experiment :1. Effect of Seed Color on Seed and Seedling Characters

Seed character

Among the three seed colours, the dark brown colour seeds had significantly superior seed length (2.90cm), seed breadth (1.28cm), 100 seed weight (149.04 g), Kernel weight (1.268 g), shell weight (0.226g) and high Kernel/shell ratio (5.45). Brown colour seeds followed this and the least seed characters were observed under light brown seeds. The seed colour is due to the maturing phases of the fruits. At full maturity, the seeds will turn dark brown in colour and has the best seed characters, which are required for a true seed **(Table-1).**

Germination Percentage and Seedling Characters

The data revealed that the dark brown seeds recorded the highest germination percent of 99 followed by brown colour seeds (84.29) and the lowest value of 61.14 was recorded under light brown seeds **(Fig. 1)**

Seed moisture content and color were the criteria for maturity in sugar maple seeds for getting maximum germination (Carl and Snow, 1971).

Significantly higher seedling characters like shoot length (9.5 cm), root length (17.3 cm), shoot weight (2.861 gm/plant), root weight (0.714 g/plant) and shoot root ratio per plant (4.00) was recorded in dark brown seeds. This was followed by brown seed and the least under light brown seeds during 45th day after sowing. Similar trend was also observed at 90th day after sowing **(Table-2)**. Higher kernel weight which is a reflection of high storage matter in the seeds for the growing seedlings has given vigorous seedlings under dark brown seeds. Dutta (1970) and Simon (1971) also found that bigger embryo had more nutrients to support more growth in plants which is in accordance with the current finding.

Experiment: 2

Effect of Seed Size on Seed and Seedling Characters

Seed characters

With regard to seed size on seed characters the results revealed that bigger seeds with a mean seed length of 3.57cm and seed breadth of 1.23cm exhibited significantly the highest Kernel weight (1.619 g). shell weight (0.342g) and high Kernel/ shell ratio (4.71). These seeds also had significantly the highest 100 seed weight (191.93 g). The above seed characters were found to be lesser under medium size seeds and the lowest under small size seeds **(Table-3).** Variation in seed size and weight in babul has been reported by Cavanagh (1980) and Suresh (1994).

Germination Percentage and Seedling Characters

The best seed characters exhibited in the big size seeds gave significantly the highest germination of 99.57 per cent **(Fig. 2)**. Heavier seeds had better germination in *A. holosercia* Hillum (1990). A close parallel exists between seed size/ weight and germination has been reported by Gawande (1985) in kapok and Thapliayal (1986) in *Pinus roxburghii.* The current finding is also on these lines.

The big size seeds also gave the best quality seedling. which was revealed when the seedling characters were assessed on 45 and 90 days after sowing. These seedlings had the highest shoot length (18.94 cm). root length (38.16 cm). shoot weight (2.108 gm/plant). root weight (0.837 g/plant) and shoot / root ratio per plant (2.525) at 90 DAS. These parameters were less under medium size seeds and the lowest under smaller size seeds. Obaho & Ali (1993) stated that the growth of seedling in *Acacia nilotica* is proportional to seed weight. The bigger seeds giving rise to bigger seedlings was due to bigger embryo which had more nutrients to support more growth has been reported by Ponnusamy *et al.* (1991) in neem. Bigger seeds imparting greater seedling vigour (Padmini & Banerjee, 1986) and the initial vigour of seedling were maintained at a later period in *A.nilotica.* (Chandragupta *et al.,* 1991) has also been reported .The current findings are in line with this, stating that bigger seeds could produce quality seedlings in *Bassia longifolia.*

Table- I. Effect of seed colour on seed characters in Bassia longifolia

Seed Characters/ Seed Colour	Seed Length (cm)	Seed Breadth (cm)	Kemal weight (g)	Shell weight (g)	Kemal / Shell ratio	100 seed weight (g)
Light Brown	2.66	1.06	0.757	0.283	2.67	105.61
Brown	2.82	1.16	1.155	0.240	4.81	134.80
Dark Brown	2.90	1.28	1.268	0.226	5.45	149.04
SEd	0.026	0.011	0.011	0.004	0.128	2.214
CD (0.05)	0.058	0.024	0.024	0.008	0.279	4.823

Table.2. Effect of seed colour on seedling characters in *Bassia longifolia*

Seedling Characters/ Seed Colour	Shoot length (cm)		Root length (cm)		Shoot weight/plant 90th Day (g)	Root weight/plant 90th day (g)	Shoot/Root Ratio
	45th day	90th day	45th day	90th day			
Light brown	4.7	8.3	10.9	18.7	0.596	2.64	
Brown	8.7	17.1	16.4	32.2	1.754	0.448	3.91
Dark Brown	9.5	18.0	17.3	34.8	2.86	1 0.714	4.00
SEd	0.193	0.332	0.297	0.390	0.031	0.064	0.016
CD (0.05)	0.420	0.723	0.648	0.850	0.067	0.140	0.035

Table -3. Effect of seed size on seed characters in *Bassia longifolia*

Seed Characters/ Seed Colour	Seed Length (cm)	Seed Breadth (cm)	Kernel weight (g)	Shell weight (g)	Kernel / Shell ratio	100 seed weight (g)
Big	3.57	1.23	1.619	0.342	4.71	191.93
Medium	2.81	1.10	1.269	0.284	4.46	154.70
Small	2.41	0.95	0.816	0.194	4.21	97.80
SEd	0.121	0.047	0.015	0.001	0.110	1.507
CD (0.05)	0.264	0.103	0.039	0.015	0.241	3.283

Table 4: Effect of seed size on seedling characters in *Bassia longifolia*

Seedling Characters/ Seed Colour	Shoot length (cm)		Root length (cm)		Shoot weight/plant 90th Day (g)	Root weight/plant 90th day (g)	Shoot/Root Ratio
	45th day	90th day	45th day	90th day			
Big	9.89	18.94	16.76	38.16	2.108	0.837	2.525
Medium	6.86	15.59	15.39	33.04	1.037	0.429	2.445
Small	4.71	9.07	11.89	26.43	0.515	0.218	2.372
SEd	0.238	0.225	0.320	0.504	0.021	0.025	0.014
CD (0.05)	0.518	0.490	0.700	1.100	0.046	0.055	0.032

Fig. 1. Effect of seed colour on seed charactes in *Bassia longifolia*

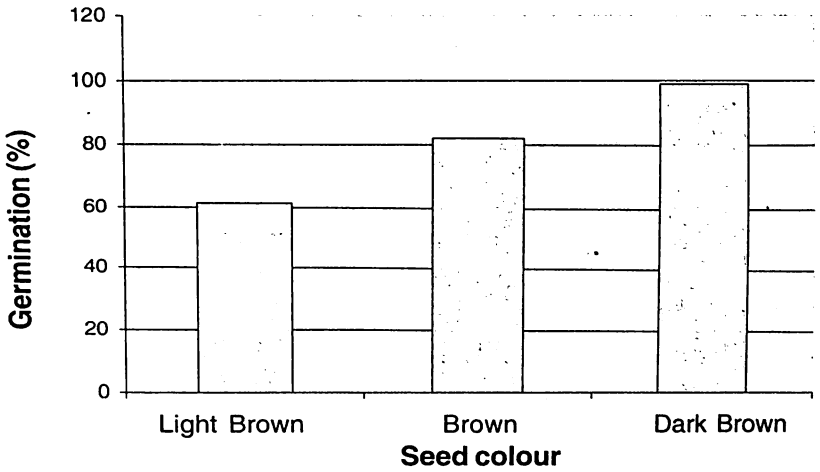
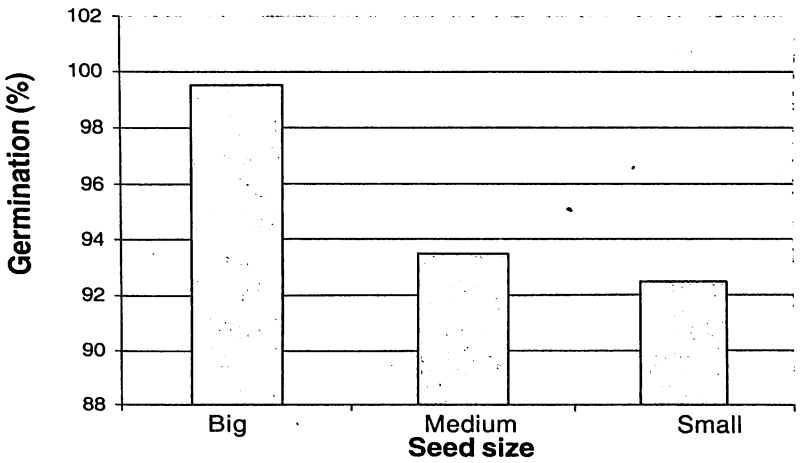


Fig. 2. Effect of seed size on germination in *Bassia longifolia*



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ANTIFUNGAL ACTIVITY OF *HOLIGARNA ARNOTTIANA EXTRACTS*

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ABSTRACT

The *in-vitro* antifungal activity of different extracts of *Heliogarna arnottiana against Rhizactonia solani* and *Cladosporium oxysporium* has been carried out. Distilled water extract inhibited the growth of both fungi to the carried out. Distilled water extract inhibited the growth of both the fungi to the maximum extent, with highest inhibition against *C.oxysporium*. Butanol and methanol extracts showed moderate growth inhibition against *C.oxysporium*, while they are ineffective against *R.solani*. Petroleum ether extract is weakly effective against *R.solani* and in ineffective against *C.oxysporium*.

Key words: Phytochemicals, fungi, extracts and anti-fungal activity

Introduction

Diseases caused by some common fungi taken together constitute the major enemy of plants. Plants are an untapped reservoir of various phytochemicals awaiting intensive exploitation for their biological properties. In the recent years, the plants are proved to be a useful source of fungitoxic substances that are rather harmless compared to synthetic chemical fungicides, which often impose undesirable side effects. Several plants have been reported to possess substances, which are toxic to mircrobial pathogens, and serve as protective barriers to infection. Compounds of plant origin have proved their effectiveness as fungitoxicity because of more systematic, easy biodegradability, low phytotoxicity and stimulation in host metabolism (Faweett and Speneer, 1969). Most of the studies on the use of plant extracts for the control of plant diseases caused by fungi indicated the possible use of various plants in actual disease control (Dubey *et al.*, 1983; Iosot *et al*, 1998). Hence an attempt has been made towards natural control for restoring the biological balance favorable to the crops.

Holigama arnottiana is a tall deciduous tree found in the Western Ghats from Konkan southwards. The tree grown best on moist, deep fertile soil of evergreen forests. All parts of the tree yield a black resinous juice, which is vesicant. The juice and bark are reported to posses medicinal properties (Anon, 1985). There are few reports available on its chemical

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and biological properties (Ramana *et al.*, 2001) The present study was undertaken to evaluate the antifungal efficacy of various extracts of *Holigarna arnottiana* on some fungi.

Materials and Methods

Preparation of plant extracts : Aerial parts of *Holigarna arnottiana* were collected from the fields in the around college of Forestry, Sirsi during September-October. The plant material was shade dried and powdered. The powdered plant material (150 gm) was subjected to soxhlet extraction separately and successively with petroleum ether (600-80°c), butanol, methanol and distilled water. The extracts were concentrated to dryness in a flash-evaporator under reduced pressure and controlled temperature. All the extracts were stored in a refrigerator.

Fungitoxic activity : The *in vitro* antifungal activity was carried against two fungi i.e., *Rhizactonia solani and Cladosoporium oxysporium.* Culture of the test fungus was maintained in agar medium. Fungitoxic activity of different plant extracts was studied by following food poisoning technique (nene & Thapliyal, 1971). A 1500 ppm solution of each extract was prepared by dissolving in sterile dimethyl formamide (DMF), 15ml of potato Dextrose medium were used in sterilized pertriplates. Experiment was carried out in three replication and observation were recorded after 7 days of inoculation. The colony diameter of the fungus along with the control was recorded. All the results are the mean values of three replications and percent growth inhibition over control was calculated and statistically analyzed following factorial CRD.

Results and discussion

The efficacy of various extracts of *Holigarna arnottiana* on the growth of the fungul cultures after seven days of inoculation and percent growth inhibitions is depicted in **Table-1.** Petroleum ether extract showed weak growth inhibition of 1.91 per cent against *R.solani*, butanol and methanol extracts showed no inhibition, whereas distilled water extractor showed high growth inhibition of 19.08 per cent and 10.50 per cent respectively against *C.oxysporium.* Distilled water extract showed high growth inhibitory effect of 39. 87 per cent against *C.oxysporium.*

Is clear from the (Fig. 1 and 2,), average colony growths were drastically affected and the variation in colony growth is significant event at 0=0.05 Distilled water extract differing significantly from the extracts. Distilled water extract inhibited the growth of both the fungi to the maximum extent, with highest inhibition against *C. oxysporium.* Methanol and butanol extracts showed moderate growth inhibition against *C.oxysporium,* while they are ineffective against *R.solani.* Petroleum ether extract is weakly effective against *R.solani* and is ineffective against *C.oxysporium. C.oxysporium* species differing significantly for *R.solani* in colony growth.

The plant extracts are more effective in inhibiting the growth of *C.oxysporium* than *R.solani.* The distilled water fraction is more effective, when compared to other extracts. The antifungal factor of plant may inhibit some specific fungi or it may exhibit a broad fungitoxic spectrum (Ramana *et al.*, 1998) The results are in agreement with the earlier reports on bioefficacy of different extracts of *Holigarna arnottiana* (Ramana et al., 2001).

The antifungal activity of different extracts is partly attributed to the presence of active phytochemicals that may interfere with the

growth and multiplication of the pathogens (Prabhakaran, (1988). There is a need of research in this area to explore potency of plants for plant health. Such control measurers would be safer to natural environment due to readily biodegradable natural of plants. Thus on account of potent fungitoxicity, *Holigarna arnottiana* can be exploited as a harmless, low cost and nonpolluting source of fungicide.

Table 1 Effect of *Holigarna arnottiana* extracts on radial growth of fungi

Crude plant extracts	Average* fungi growth (in mm)		Inhibition of fungi growth over control (%)	
	Rhizoctonia solani	*Cladosporium oxysoporium*	*Rhizoctonia solani*	*Cladosporium oxysoporium*
Pet.ether	17.00	17.30	1.91	0.00
	(24.35)	(24.58)	(1.70)	(1.00)
Butanol	20.60	13.10	0.00	8.40
	(31.05)	(21.22)	(1.00)	(3.06)
Methanol	24.30	12.80	0.00	10.49
	(29.53)	(20.96)	(1.00)	(3.38)
Distilled	14.00	8.60	19.08	39.87
water	(24.80)	(17.05)	(4.48)	(4.48)
Control	17.33	14.30	-	-
	(24.80)	(22.22)		
C. D. at 5%	0.123	0.123	0.074	0.074

* Each value is the mean of three replications and values in parenthesis are the angular transformed values.

Fig. 1 Effect of *H.arnottiana* extracts on fungal growth

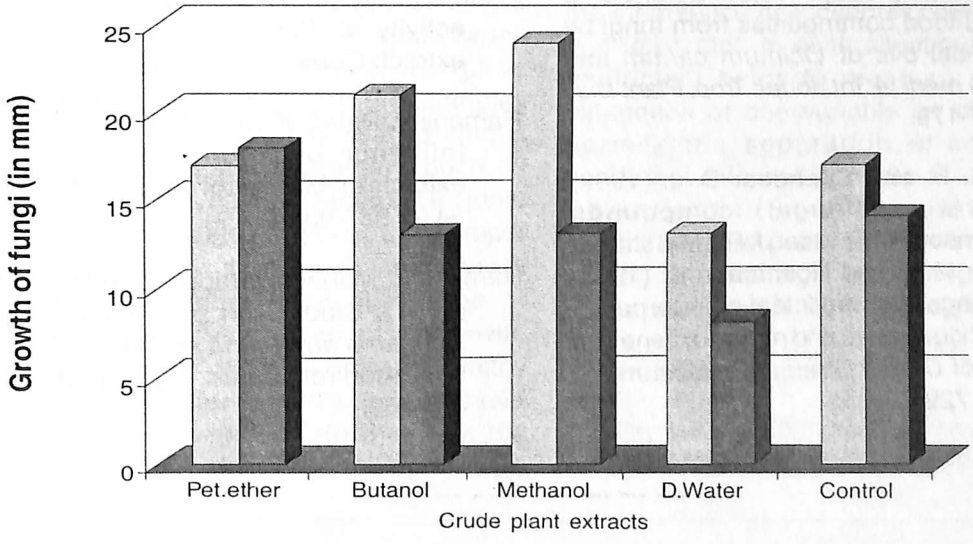
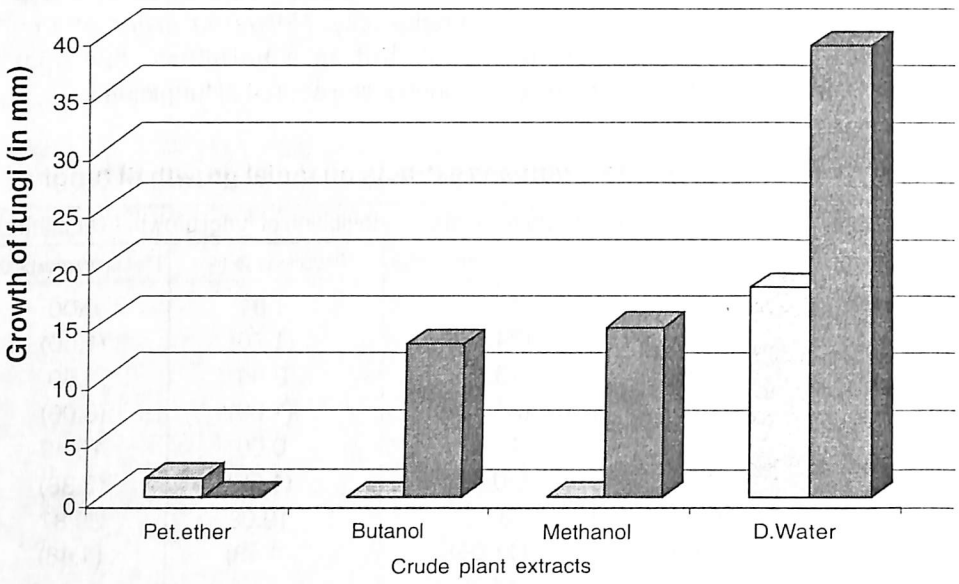


Fig. 1 Effect of *H.arnottiana* extracts on fungal growth



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PATH CO-EFFICIENT ANALYSIS IN *TERMINALIA ARJUNA* BEDD. GROWN IN NURSERY AT SEEDLING STAGE

SANTOSH KUMAR AND M.H.SIDDIQUI*

ABSTRACT

The correlation and path coefficient studies made on five growth parameters (seedling height, collar diameter, root length, leaf area and leaf number) of *Terminalia arjuna Bedd.* grown in polythene tube has indicated that seedling height, leaf number and leaf area has directly contributed in dry matter production, whereas minimal direct effect was noticed by root length and collar diameter.

Key words: Terminalia arjuna, growth parameters, biomass, path coefficient

Introduction

Terminalia arjuna Bedd. commonly called as Arjun is found throughout the tropical and subtropical regions of the peninsular India along the rivers and water courses. It attains large size on fertile and alluvial loam soils (Srivastav *et. at.*, 1993). The leaves of this tree are fed to tasar silkworm *Antheragea mylitta* Drury. for rearing of tasar cocoon (Jolly *et. at.,* 1968). The tree growth is a complex phenomenon which is associated with a number of component character's such as edaphic as well as climatic factors. Besides, the genetic factor is also responsible for proper growth. In natural conditions the tree growth generally is affected from the stage of germination till its establishments. However, in artificial plantation good growing healthy seedlings are prefered because, they have bearing on future growth. In this way, the various growth parameters such as seedlings height, collar diameter, root length, leaf area etc. play vital role in production of healthy seedling, which is reflected through biomass of seedling. The interdependence of contributing factors affects their direct relationship with dry biomass. As more variables are included in correlation studies the inheritence associators comes complex and important. In such situations the path coefficient helps to measure the direct infleuence of one variable on other's and permits the separation of correlation coefficient into components of direct .and indirect effect (Srivastava and Chauhan, 1996). Therefore, path coefficient analysis was carried out by taking five growth parameters on the seedlings of *Terminalia arjuna* .

Material and methods

The seeds of *Terminalia arjuna* Bedd. were collected from the *Terminalia arjuna* orchard

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located in the permises of Birsa Agricultural University, Ranchi. The seeds were sown in polythene tubes containing different doses (mg of fertilizers per polythene tube) thus giving 15 treatments including control (Control, N_{50}, N_{100}, N_{150}, P_{50}, P_{100}, P_{150}, K_{25}, K_{50}, K_{75}, $N_{50}P_{50}$, $N_{50}K_{50}$, $P_{50}K_{50}$, $N_{50}P_{50}K_{50}$, $N_{100}P_{100}K_{50}$) and polythene tubes were placed in nursery in Completely Randomised Design (C. R. D.) under three replications. The experiment was conducted from May 1999 to December 1999 and observations were recorded at monthly intervals starting from second month to seventh month. The parametes included seedling height, root length, collar diameter, number of leaf, leaf area and dry matter production. The correlation coefficient between dry matter production (g) and other growth characters were calculated with the help of computer. The path coefficient was also worked out following the method of Dewey and Lu (1959) in computer.

Results and Discussion

The correlation coefficient between Dry matter Produciton (g) and other growth characters of *Terminalia arjuna* Bedd. is given in **Table 1.** Maximum value of correlation coefficient was found between seedling height and collar diameter (0.9064) and minimum values were noticed between seedling height and root length (0.5968). The dry matter production showed highly significant relation with leaf number, seedling height, leaf area, collar diameter and root length.

Path diagram with effects of five variables on dry matter production is shown in **Figure 1.** In the path diagram the double arrowed lines indicated mutual association measured by correlation coefficient between two growth variables and 'X' represents the Residual factors,

The data on direct and indirect contributions of five growth parameters *viz.*, seedling height, root length, collar diameter, leaf number and leaf area in dry matter production of *Terminalia arjuna* Bedd. is shown in **Table 2,** which has been calculated with path coefficient analysis. Seedling height, leaf number and leaf area have directly contributed in dry matter production and minimal direct effect was noticed by growth parameters such as root length and collar diameter. Out of five growth parameters, the seedling height exhibited maximum direct positive effect (0.4480), whereas, indirect effect was observed through leaf number (0.3560). Srivastava and Chauhan (1996) found direct positive effect of seedling height, number of leaves, root fresh weight, root dry weight, while direct negative effect by collar diameter, leaf area, shoot fresh weight in case of *Bauhinia variegata.*

The root length exhibited direct negative effect (-0.2321), whereas indirect effect was observed for seedling height (0.4060), leaf number (0.3585); leaf area (0.3163) and root length (-0.0517). Jindal *et al.* (1999) have also negative contribution of root length for production of shoot dry weight of *Azadirachta indica.* Leaf number exhibited positively direct effect (0.4285), whereas indirect effect was observed for seedling height (0.3722). Similarly, leaf area showed direct effect (0.3800), whereas indirect effect was observed for seedling height (0.3361).

The correlation coefficient between dry biomass production and other growth parameters were in the order of leaf number (0.8548) > seedling height (0.8342) > leaf area (0.8009) > collar diameter (0.79.70) > root length (0.5636). In agreement to the present findings, Dhillon *et al.* (2000) have also

revealed that seedling height, weight of leaves and height up to first branch contributed more directly to the collar diameter at seedling stage in *Dalbergia sissoo.*

The present findings have indicated that the characters like root length and collar diameter may not be considered as effective parameters of selection, while leaf number, seedling height and leaf area should be given more emphasis during selection programrne for *Terminalia arjuna* Bedd.

Acknowledgement

The first author is thankful to Birsa Agricultural University for providing financial assistance for the present study.

Table -1. Co-relation Co-efficient between Dry Matter Production (g) and other growth characters in *Terminalia arjuna* Bedd. seedling grown in nursery

	Seedling height (cm)	Root length (cm)	Collar diameter (cm)	Leaf number (perplant)	Leaf area (cm^2)	Dry Matter (gm)
Seedling height (cm)	1.0000	0.5968*	0.9064**	0.8310**	0.7503**	0.8347**
Root length (cm)		1.0000	0.7001**	0.6101*	0.7137**	0.5636*
Collar diameter (cm)			1.0000	0.8366**	0.8324**	0.7970**
Leaf number (per plant)				1.0000	0.7718**	0.8548**
Leaf area (cm^2)					1.0000	0.8009**
Dry matter (gm)						1.0000

* significant at 5°% (Tabular value = 0.497)
** Highly significant at 1% (Tabular value = 0.623)

Table-2. Direct and indirect effects of five growth on Dry Matter Production of *Terminalia arjuna* Bedd. seedling grown in nursery

	Seedling height (cm)	Root length (cm)	Collar diameter (cm)	Leaf number (perplant)	Leaf area (cm^2)	Co-relation Co-efficient
Seedling height (cm)	**0.4480**	-0.0440	-0.2104	0.3560	0.2851	0.8347
Root length (cm)	0.2673	**-0.0738**	-0.1625	0.2614	0.2712	0.5636
Collar diameter (cm)	0.4060	-0.0517	**-0.2321**	0.3585	0.3163	0.7970
Leaf number (per plant)	0.3722	-0.0450	-0.1942	**0.4285**	0.2933	0.8548
Leaf area (cm^2)	0.3361	-0.0527	-0.1932	0.3307	**0.3800**	0.8009

Residual effect = 0.4268

Numbers in Bold shows direct effect of a characters on dry matter production

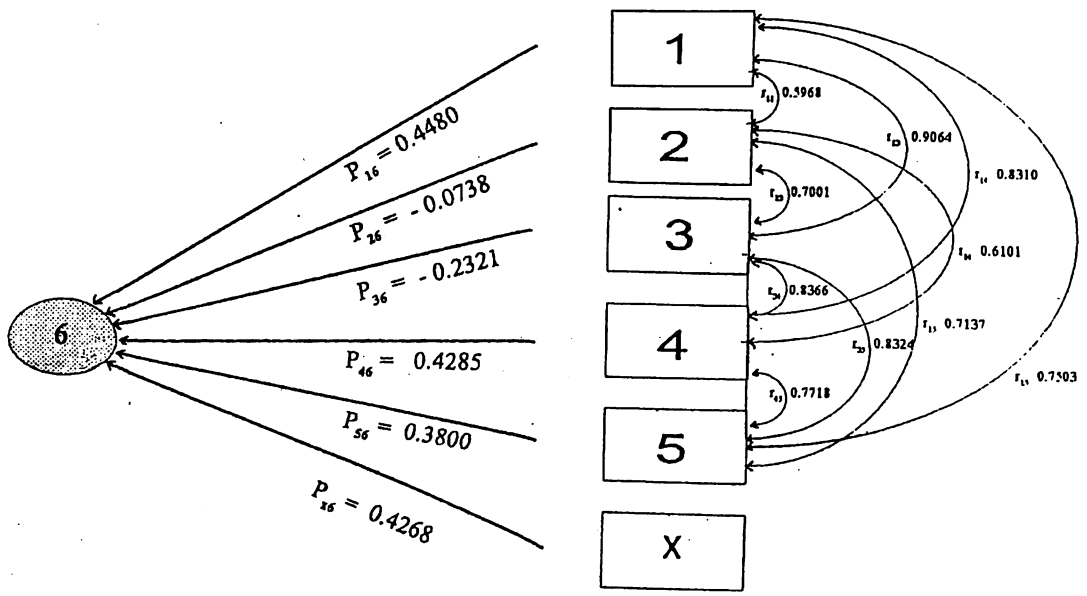

Figure 1

1 - Seedling height 2 = Root length 3 = Collar diameter 4 - le af number
5 = Leaf area 6 = Dry weight X = Residual Factors

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EFFECT OF DIFFERENT PRE-SOWING TREATMENTS ON SEED GERMINATION AND SEEDLING QUALITY PARAMETERS IN *ACACIA NILOTICA*

HUNUMANTHA, M*., GIRISH SHAHAPURMATH, DODDABASAWA, ROOPA S. PATIL and VASUDEVA, R.

ABSTRACT

Acacia nilotica is valued for its leaf and pod fodder, small timber, charcoal *etc.* Investigation was carried out to know the effect of pre-sowing treatments on germination per cent and seedling quality parameters of *A. nilotica*. Enhanced germination per cent and seedling quality parameters were observed in hot water followed by Conc. H_2SO_4 treatments. Hot water treatment for 15 minutes followed by Conc. H_2SO_4 for 60 minutes showed highest germination per cent (92.66), germination value (17.20), plant height (13.96 cm) and seedling vigour index (2602). This is due to combined effect of hot water and Conc. H_2SO_4. Interestingly, seeds collected from pellets of sheep and seeds treated with cow dung also showed increased germination per cent (79.53 and 66.33 respectively) as compared to that of control (38.40%).

Introduction

Acacia nilotica (Babul belonging to family Leguminaceae (sub family-Mimosoidae), is a moderate thorny tree, almost evergreen with short trunk, a spreading crown and feathery foliage (Troup, 1921). Babul tree is of considerable economic importance in many places. It is an important multipurpose popular species is now been planted in large scale on tank foreshore (Shetty, 1977), waste lands and as an Agroforestry species. The tree is valued for its leaf and pod fodder, small timber, firewood, and charcoal and gum. The timber is a favourite wood for cart making, agricultural implements, hammers and crushes beams, door and window frames and railway sleepers.

To achieve any success in any plantation proprammes, a good start is essential from the germination stage. For efficient germination adequate moisture supply, appropriate gaseous balance and light is very essential. Seeds of *A. nilotica* show dormancy and without pre-sowing treatments, the germination per cent is very low. The seeds possess hard seed coat impermeable to water, as in most of the leguminous plants. When the seeds are sown without pre-treatment, they germinate very slowly. Several workers conducted experiments to overcome dormancy and to enhance germination per cent by giving different pre-treatments. Karihaloo (1980) conducted experiment to know the effect of mechanical and chemical scarification and hot water treatment to enhance seed

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germination by removing dormancy in *Acacia sp.* Shivanna *et al.* (2002) also suggested that, treating *Acacia nilotica* seeds with conc. H_2SO_4 at different time intervals can enhance germination per cent and seedling quality parameters.

Therefore, the present study was carried out to find out effectiveness of conc. H_2So_4, hot water treatment and some other biological pre-treatments in reducing seed coat dormancy and its effect on germination per cent and seedling quality parameters under glass house conditions.

Materials and method

The study was conducted during 2001-02, at College of Forestry, Sirsi. Mature pods were collected from *Acacia nilotica* trees. Seeds were removed from the pods and were cleaned. The selected seeds were surface sterilized by keeping them Mercuric chloride (0.01%) for 3-5 minutes. In order to know the effect of pre-sowing treatments on germination per cent and seedling quality, the following treatments were imposed.

Treatments

T_1 – Soaking in cold water for 24 hours (control).

T_2 – Soaking in hot water for 10 minutes.

T_3 – Soaking in old water for 15 hours.

T_4 – Soaking in Conc. H_2SO_4 for 30 minutes.

T_5 – Soaking in Conc. H_2SO_4 for 60 minutes.

T_6 – Soaking in hot water for 10 minutes followed by Conc. H_2SO_4 for 30 minutes.

T_7 – Soaking in hot water for 10 minutes followed by Conc. H_2SO_4 for 60 minutes.

T_8 – Soaking in hot water for 15 minutes followed by Conc. H_2SO_4 for 30 minutes.

T_9 – Soaking in hot water for 15 minutes followed by Conc. H_2SO_4 for 60 minutes.

T_{10} – Seeds collected from pellets of sheep.

T_{11} – Heaping seeds with cow dung for 5 days.

Seeds were sown on sand bed in three replications with 100 seeds for each replication. Emergence of plumule above the sand was taken as the criterion of germination. The germination of seeds under each treatment was recorded everyday upto 21 days from the day of sowing. Based on daily germination count the following parameters were computed.

1) Germination Percentage $= \frac{\text{Number of Normal seeds germinated}}{\text{Number of seeds sown}} \times 100$

2) Germination Value (GV) = Mean Daily Germination (MDG)x Peak Value (PV)

$$MDG = \frac{\text{Total Germination Percentage}}{\text{Total Number of days}}$$

$$PV = \frac{\text{Final Germination Percentage}}{\text{Number of days that took to reach the peak germination}}$$

3) Seedling Vigour index (SVI): SVI was computed by adopting the following formula.

SVI= Mean Germination percentage x Mean seedling length (cm)

4) Seedling Fresh Weight (SFW): Immediately after removing the seedling from the

germination paper (after 21 days), whole seedling was weighed and considered as fresh weight and expressed in grams.

5) Seedling Dry Weight (SDW): Ten seedlings used for seedling length measurement were utilized to determine dry weight of seedling. These seedlings were dried in hot air oven 60 ± 1 C for constant weight and the dry weight of seedling was expressed in grams.

The experiments were laid out in a completely Randomized Design (CRD) with three replications and data were subjected analysis of variance (ANOVA) as suggested by Snedecor and Cochron (1967) and the means were compared using Duncan's Multiple Range Test (DMRT). Arc-sine transformation was applied for the values expressed in percentages.

Results and discussion

The per cent germination and other seedling quality parameters of tree species are important factors, which determine the quality and potential performance of seed. This experiment compared of 11 treatments with three replications each. These treatments were compared for their germination per cent, germination value, seedling vigour index, seedling fresh weight and seedling dry weight. Results obtained on these parameters are presented in **(Table-1)**.

1) Per cent germination: Seed germination was affected by conc. H_2SO_4, hot water and biological factors **(Table-1 and Fig-1)**. In general per cent germination was maximum in T_9 (92.66%) followed by T_8 (91.76%) and T_7 (90.76%). Lowest germination was observed in T_1 - control (36.40). Treatment T_9 differed significantly with all other treatments except T_8 and T_7 these two treatments are on par with T_9. These results are in broad agreement with Shivanna *et al.* (2002). They were reported maximum germination of 92.75 per cent for the seeds treated with Conc. H_2SO_4 for 75 minutes and lowest germination per cent of 31.75 for control in *Acacia nilotica*. Hanumantha *et al.* (2002) reported highest germination per cent of 81.50 for the seeds treated with 150ppm IAA followed by hot water treatment and lowest of 22.00 percent for cold water treated seeds in *Albizia lebeck*.

In this study the seeds treated with dung and seeds collected from pellets of sheep also showed increasing germination per cent as compared to normal seeds. From this study it was concluded that hot water treatment with higher concentration of H_2SO_4 would give better germination per cent with more vigorous seedlings. The enhancement of germination per cent is attributed to the effect of both hot water and chemical substances present in H_2SO_4.

2) Mean daily germination (MDG): Mean daily germination was also affected with hot ware and Conc. H_2SO_4 treatments **(Table-1)**. Maximum MDG was observed in T_9 (4.80) followed by T_8 (4.77) and T_7 (4.63). These three treatments were on par with each other for MDG. Lowest MDG was recorded for control (1.91) followed by T_2 (2.38). Similar results were reported by Shivanna *et al.* (2002) in *Acacia nilotica*. Maximum MDG was recorded for seeds treated with Conc. H_2SO_4 for 75 minutes (4.41) and least MDG in control (1.50).

3) Germination value (Gv): Germination value was significantly affected by the hot water and Conc. H_2SO_4 treatments **(Table-1).** The seeds treated with hot water for 15

minutes followed by Conc. H_2SO_4 for 60 minutes (T_9) showed highest germination value (17.20) compared to other treatments. lowest Gv was observed in control (6.50) as compared to treated seds. Treatments T_9 differed significantly with all other treatments for Gv except T_8 (16.83) and T_7 (16.50), these three treatments were on par with each other. These results are in agreement with Shivanna *et al.* (2002). They reported maximum Gv of 15.75 for the seeds treated with Conc. H_2SO_4 for 60 minutes and the lowest was recorded in control (4.09).

4) Plant height: Plant height was significantly affected by hot water and Conc. H_2SO_4 treatments (**Table 1**). The highest plant height was recorded in T_9 (13.96 cm) followed by T_8 (13.36 cm). The lowest plant height was recorded in control (6.10 cm). The seeds that are collected from pellets of sheep also showed increased plant height (9.03 cm) as compared to control (6.10 cm), but results of T_{10} and T11 did not show any significant difference for plant height. Similar results were obtained by Hanumantha *et.al* (2002) in *Albizia labbeck.* The highest plant height was recorded for seeds treated with 150ppm IAA with hot water treatment (11.22 cm) and lowest in cold water treatment (7.37 cm).

5) Seedling vigour index (SVI): Seedling vigour index also increased with different pre-treatments (**Table-1** and **Fig-1**). Maximum SVI was recorded in T_9 (2602) followed by T_8 (2562) and least in control (618). Pre-sowing treatments influences SVI in several spiecies.Shivanna *et al.* (2002) showed increase in SVI with increase in duration of Conc. H_2SO_4 treatment.Maximum SVI was recorded for the seeds treated with Conc. H_2SO_4 for 75 minutes (2905) followed by Conc. H_2SO_4 treatment for 60 minutes (2427) and least was recorded in control (582) in *A. nilotica.* Seeds treated with dung also showed increased SVI (1784) as compared to control.

6) Seedling Fresh Weight (SFW) and Seedling Dry Weight (SDW): Seedling fresh weight and Seedling dry weight also increased with different pre-treatments **(Table 1)**. Maximum SFW and SDW were recorded in treatment T_9 (1.68g and 0.46g respectively) followed by T_8 (1.64g and 0.44g respectively) and least was recorded in control (1.17g and 0.09g respectively). Seeds treated with hot water 15 minutes followed by Conc. H_2SO_4 for 60 minutes differed significantly with all other treatments for SDW. These results are in agreement with Shivanna *et al.* (2002), they recorded maximum SFW (1.56g) for the seeds treated with Conc. H_2So_4 treatment for 75 minutes and maximum SDW (0.123g) for the same treatment.

From this study we can conclude that, values of all the traits increased as duration of (hot water and Conc. H_2SO_4) pre-treatment is increased. The traits showed maximum value T_9 (hot water for 15 minutes followed by Conc. H_2So_4 for 60 minutes) followed by T_8 (hot water for 10 minutes followed by Conc. H_2SO_4 for 30 minutes)and least in control. This is due to the effect of hot water treatment and pre-sowing chemicals attributed to change in membrane permeability (Shivakumar *et al.*,2002). Hence, it is concluded from the above study that pre-treatment with hot water for 15 minutes followed by Conc. H_2SO_4 for 60 minutes is optimum for obtaining enhanced seed germination and vigour of the *A. nilotica* seedlings.

Table 1 – Effect of pre-sowing treatment on per cent germination and growth attributes of *Acacia nilotica*.

Treatment	Per cent germination	Mean Daily germination	Germination value	Plant height (cm)	Seedling Vigour Index	Seedling Fresh Weight (g)	Seedling Dry Weight (g)
T_1(Cold water - 24 hrs)	38.40 (38.29)	1.91	6.50	6.10	618	1.17	0.09
T_2(Hot water - 10min)	52.56 (46.49)	2.38	8.93	7.80	685	1.18	0.16
T_3(Hot water - 15min)	56.23 (48.56)	2.77	9.10	8.10	692	1.19	0.18
T_4(Conc.H_2SO_4 - 30 min)	58.86 (50.13)	3.77	12.60	8.96	1938	1.27	0.22
T_5(Conc.H_2SO_4-60min)	86.36 (68.36)	4.16	15.23	11.03	2316	1.32	0.31
T_6(Hot water - 10 min+ Conc.H_2SO_4-30 min	88.10 (69.73)	4.21	15.53	11.70	2304	1.35	0.37
T_7(Hot water - 10 min+ Conc.H_2SO_4 - 60 min)	90.76 (72.34)	4.63	16.50	12.53	2498	1.39	0.41
T_8(Hot water - 15 min+ Conc.H_2SO_4 - 30 min)	91.76 (73.36)	4.77	16.83	13.36	2562	1.64	0.44
T_9(Hot water - 15 min+ Conc.H_2SO_4 - 60 min	92.66 (74.32)	4.80	17.20	13.96	2602	1.68	0.46
T_{10}(Seeds from pellets of sheep)	79.53	3.67	12.46	9.03	1948 (63.08)	1.33	0.23
T_{11}(Cowdung treatment - 5 days)	66.33	2.98	11.20	8.88d (54.51)	1784c	1.31	0.18
CV	2.66	6.42	4.87	4.09	6.36	5.06	5.07
S.Em+	1.14	0.13	0.36	0.23	66.6	0.04	0.005
CD	3.37	0.40	1.07	0.70	195.40	0.12	0.02

* Values in parentheses indicate arc sine transformed values.

Fig 1. Effect of pre-sowing treatments on per germination in *A. nilotica*

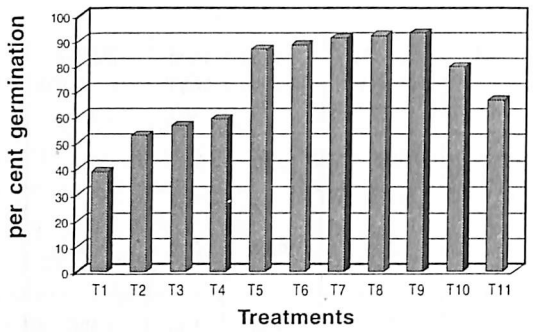
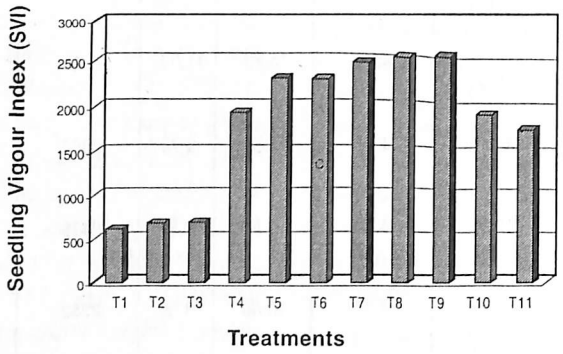


Fig 2. Effect of pre-sowing treatments on Seeding Vigour Index in A. nilotica



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Government of Karnataka

No DPAR 49 SFP 2003

Karnataka Government Secretariat
Vidhana Soudha, Bangalore

Dated 19th May, 2003

NOTIFICATION

Shri. Avani Kumar Varma, IFS (KN 74), Chief Conservator of Forests and Chief Executive, Lade Development Authority, Bangalore, is promoted to officiate in the rank of Additional Principal Chief Conservator of Forests, Carrying the above Super Time Scale of pay of IFS viz., Rs. 22400-525-24500 with immediate effect and he is continued until further orders as Additional Principal Cheif Conservator of Forests and Chief Executive Officer, Lade Development Authority, Bangalore, in the upgraded post.

Shri Chellam Swamy Raju, IFS, (KN 79), Conservator of Forests, (Communication & Information), Bangalore, is promoted to officiate in the rank of Chief Conservator of Forests, Carrying the Super Time Scale of pay (Level 1) of IFS i.e., Rs. 18,400-500-22400, with immediate effect and he is continued to be posted untill further orders as Cheif Conservator of forests (Communication and Information), Bangalore, in the upgraded post.

Shri M.H. Swaminath, IFS, (KN 79), Conservator of Forests and Director General, Environment Management and Policy Research Institute, (EMPRI), Bangalore, is Promoted to officiate in the rank of Chief Conservator of Forests, carrying the Super Time Scale of pay (Level 1) of IFS i.e., Rs. 18,400-500-22400, with immediate effect and he is continued until further orders for posting him as Chief Conservator of Forests and Director General, Environmental Management and Policy Research Institute, (EMPRI), Bangalore, in the upgraded post.

Shri M.N. Jayakumar, IFS, (KN 79), Conservator of Forests and Director (Forests), Mysore Paper Mills Ltd., Bhadravathi, is promoted to officiate in the rank of Chief Conservator of Forests, carrying the Super Time Scale of Pay (Level 1) of IFS i.e., Rs. 18,400-500-22400, with immediate effect and he is continued until further orders for posting him as Chief Conservator of Forests and Director (Forests), Mysore Paper Mills Ltd., Bhadravathi, in the upgraded post.

The Services of Shri M.V. Krishnegowd, a IFS (KN 85), Conservator of Forests and General Manager, Karnataka State Forests Industries Corporation Ltd., Bangalore, are withdrawn from the Forests, Ecology and Environement Department with immediate effect and are placed at the disposal of Information, Tourism and Youth Services Department until further orders for posting him as Conservator of Forests, Jungle Lodges and Resorts, Banglore, vice Shri M. Nagaraj Hampole, IFS, transferred.

The services of Shri M. Nagaraja Hampole, IFS (KN 85), Conservator of Forests, Jungle Lodges and Resorts, Bangalore, are withdrawn from the Information, Tourism and Youth Services Department with immediate effect and he is posted until further orders as Chief Executive Officer, Zilla Panchayat, Davanagere District, Davanagare, vice Shri N. Prabhakarappa, KAS, transferred.

Shri K.N. Murthy, IFS (KN 85), Deputy Conservator of Forests, Wildlife Division, Karkala, is promoted to officiate in the rank of Conservator of Forests, carrying the super time pay scale (Level 2) of IFS i.e., Rs. 16,400-450-20,000, with immediate effect and he is posted until further orders as chief Executive Officer, Zilla Panchayat, Chamarajanagar District, Chamarajanagar, vice Shri H.G. Srivara, KAS, transferred.

Shri S.M. Puttabudhi, IFS (KN 85), Deputy Conservator of Forests (Development), Bangalore, is promoted to officiate in the rank of conservator of Forests, carrying the Super Time Pay scale (Level-2) of IFS i.e., Rs 16,400-450-20,000 with immediate effect and he is posted until further orders as Conservator of Forests, Bellary Circle, Bellary, vice Shri. K. Yekantappa, IFS, transferred.

Shri P.L. Budhihal, IFS (KN 85), Deputy Conservator of Forests, Zilla Panchayat, Shimoga, is promoted to officiate in the rank of conservator of Forests, carrying the Super Time Pay scale (Level-2) of IFS i.e., Rs. 16,400-450-20,000, with immediate effect and he is posted until further orders as chief Executive Officer, Zilla Panchayat, Kodagu District, Madikeri, vice Shri M.K. Baladevakrishna, KAS, transfferred.

Shri H.G. Shivanada Murthy, IFS (KN 85). Deputy Conservator of Forests, Yellapur division, Yellapur, is promoted to officiate in the rank of Conservator of Forests, carrying the Super Time Pay scale (Level -2) of IFS i.e.,Rs. 16,400-450-20,000, with immediate effect and he is posted until further orders as Chief Executive Officer, Zilla Panchayat, Dakshina Kannada District, Mangalore, in the existing vacancy.

By Order and in the name of the
Governor of Karnataka

(U.P. Prabhu)
Under Secretary to Government
D.P. & A.R. (Services-2)

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10. All common/local names should suffixed with botanical/zoological/scientific names.
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Aegle marmelos (L.) Correa

Common Names : Bilvapathre, Bael.
Family : Rutaceae.
Habitat : Deciduous to Scrub forests.
Distribution : India, Burma.

Uses : The unripe or half-ripe fruit is regarded as astringent, digestive and stomachic. It is beneficial in cases of diarrhoea and dysentery. The ripe fruit is sweet, aromatic and cooling. Generally used in the form of sherbet. Leaves are much used as religious offerings in temples.

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